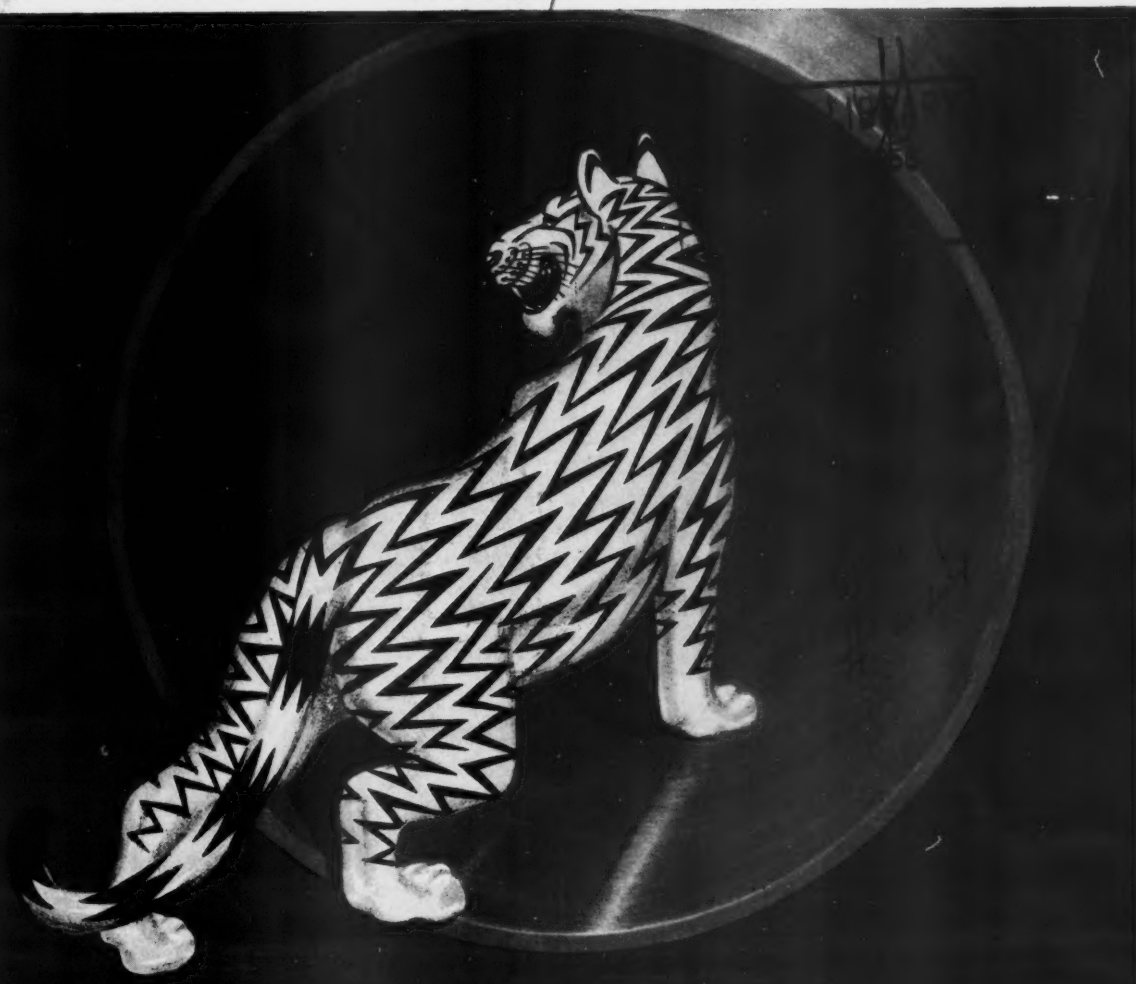
March–April–May, 1956

Plastics

DEALING WITH THE MANUFACTURE, USES AND POTENTIALITIES OF PLASTIC MATERIALS



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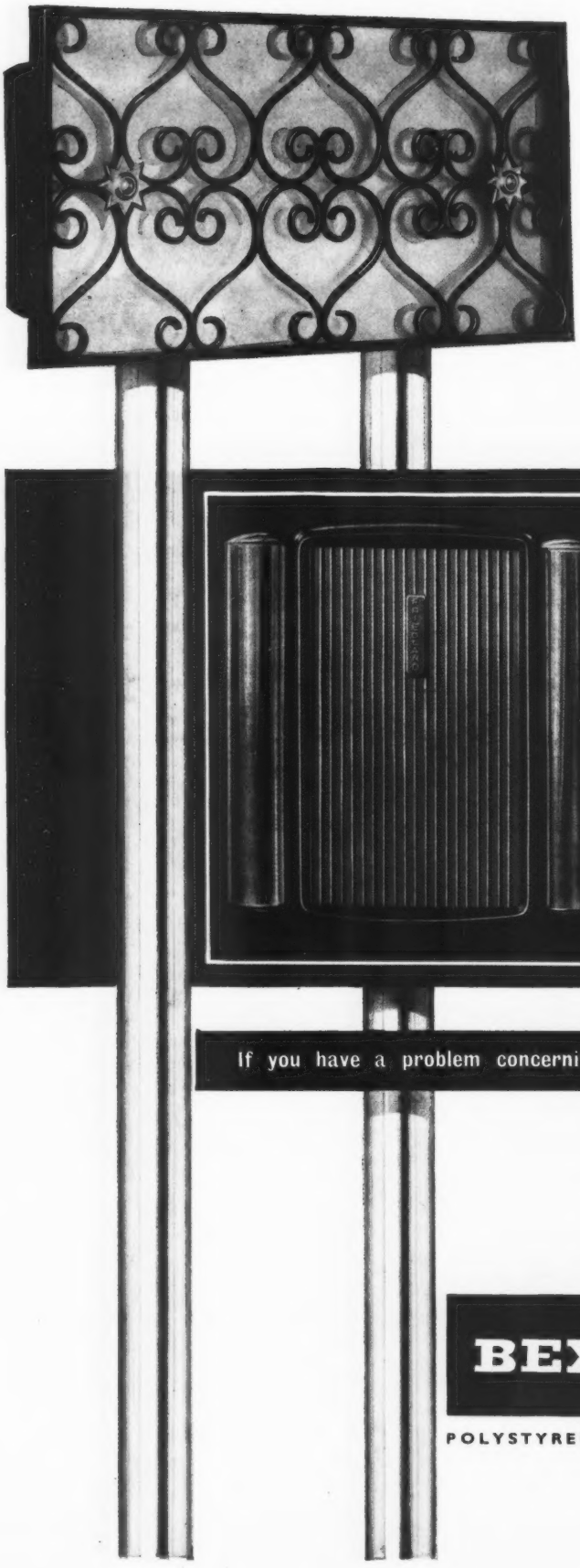

BX RINGS THE BELL

Ornamental Grille and Reflector Plate of the "Monarch" Electric Door Chime is moulded from Bexoid, and the two tone front panel of the "Warbler" Mark II from Bextrene. Both these elegant cases are moulded by Messrs. Punfield & Barstow Ltd. for Messrs. F. & E. Friedland of Macclesfield.

If you have a problem concerning moulding powders — contact BX first

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CELLULOSE ACETATE MOULDING POWDER

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POLYSTYRENE MOULDING POWDER

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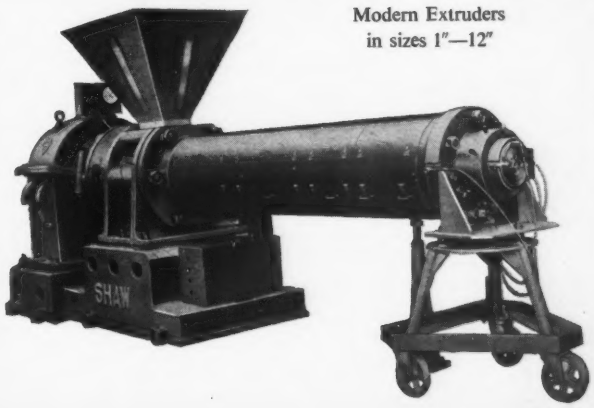

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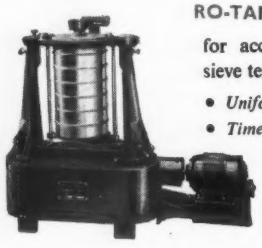

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for accurate and consistent sieve testing.

- *Uniform mechanical action.*
- *Time switch control.*
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to reduce a large sample for making sieve tests.

- *Made in two sizes for heavy tinned steel.*
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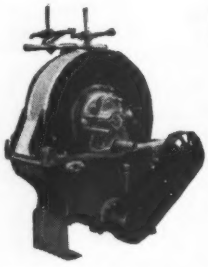
- *Both sizes discharge alternately in opposite directions.*



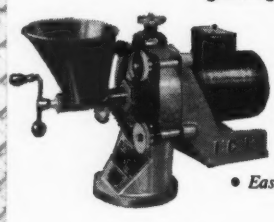
ROVAC LABORATORY FILTER—

complete working reproduction of larger machine.

- *Built on cell principle: 3 sq. ft. filtering area.*
- *Belt drive, fast and loose pulleys.*

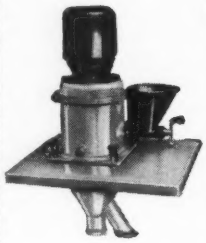
RAYMOND LABORATORY MILL—

grinding non-abrasive materials.



- *Rotor has eight steel swing hammers and runs at high speed.*
- *Supplied with five perforated steel screens, of different sizes, to suit product.*
- *Easily dismantled for cleaning.*

RAYMOND LABORATORY SEPARATOR—



self-contained air unit for dry particle size classification.

- *Separating chamber encloses all rotating parts.*
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- *Motor bearings grease-packed. No oiling required for separator parts.*

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STANDARD INJECTION MACHINES				
MODEL NUMBER	150-H-6	300-H-12	400-H-20	800-H-48
Capacity (oz.–Single Feed)	6	12	20	48
Capacity (oz.–Double Feed)	8	16	28	64
Material Injected (cu. in. per min.)	440	1035	1330	2895
Plasticizing Capacity (lbs. per hour)	60	100	135	350
Mould Clamp Capacity (tons)	150	300	400	800
Mould Space (hor. × vert.):				
(*a*) Full Platen Vert.	10½″ × 25″	16½″ × 33″	20½″ × 42″	36″ × 54″
(*b*) Full Platen Hor.	20½″ × 15″	30″ × 20″	36″ × 26½″	54″ × 36″
Daylight Opening without Ram Spacer	20″	30″	40″	55″
Daylight Opening with Ram Spacer	16″	26″	34″	47″
Mould Thickness without Ram Spacer	10″	10″	15″	20″
Mould Thickness with Ram Spacer	6″	6″	9″	12″
Clamp Travel (max.)	10″	20″	25″	35″
Motor Horse-power	20	40	50	100
Shipping Weight (pounds)	14500	22000	39000	75000

NOTE: All ratings based on moulding general purpose polystyrene

From 6 ounces to 400 ounces; with mould clamping pressures from 150 tons to 3,000 tons . . . that's the scope of the new H.P.M. range.

Each machine is new, designed with many outstanding features. High capacity plasticizing chambers, weigh feeders, greater 'shot' capacities, increased daylight and stroke, quiet pumps, and sub-plate mounted valves reducing piping to the absolute minimum, are some of the reasons why H.P.M.'s mould better, faster and at lower cost.

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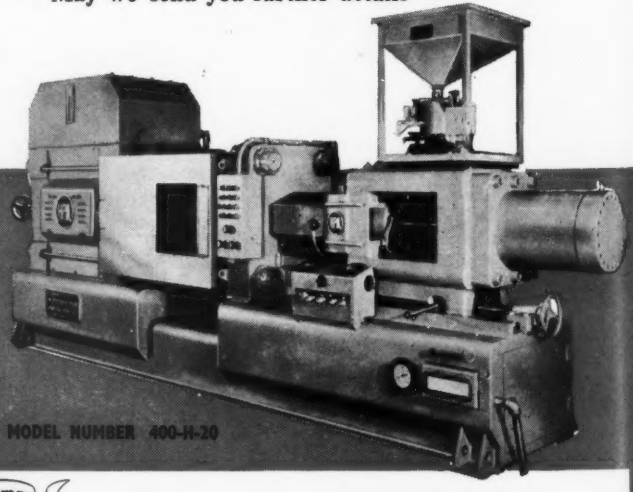

MODEL NUMBER 400-H-20

Other H.P.M. Models are available with these capacities:—

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Model 600-H-32 Capacity 32 ounces.
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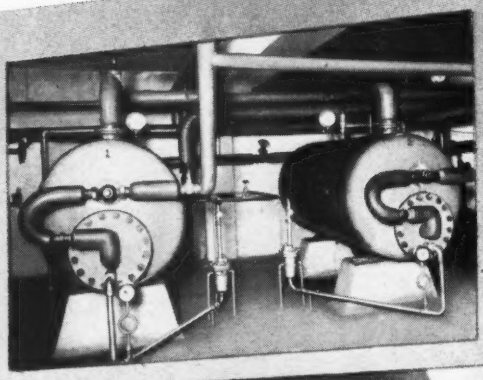
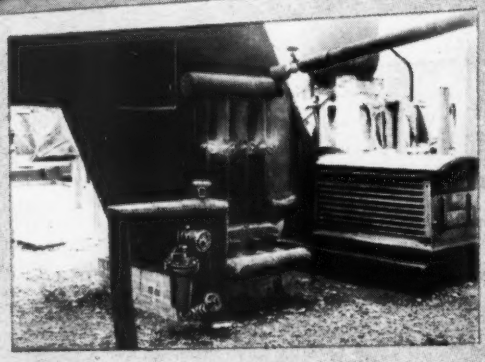
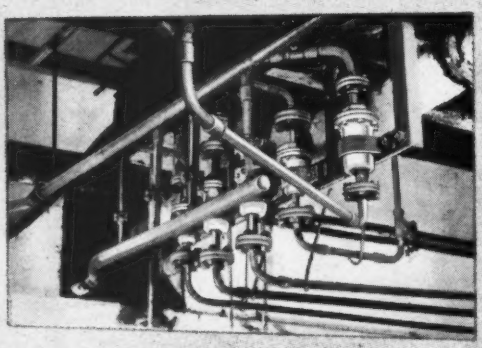


Drayton/Armstrong steam traps installed in a nurses' home in 1938. Inspected at regular intervals and no spares required.



Drayton/Armstrong steam trap draining Cellopas dryer in large chemical works. Age unknown.



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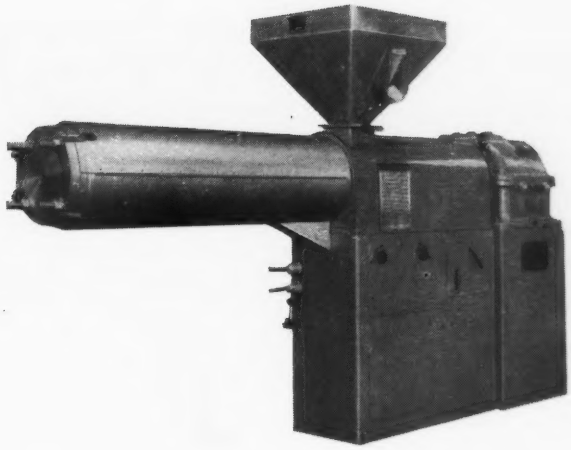

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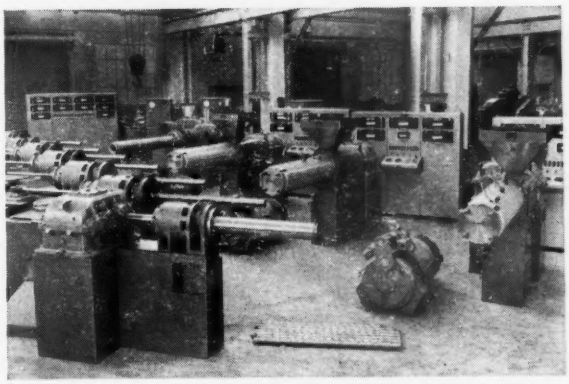

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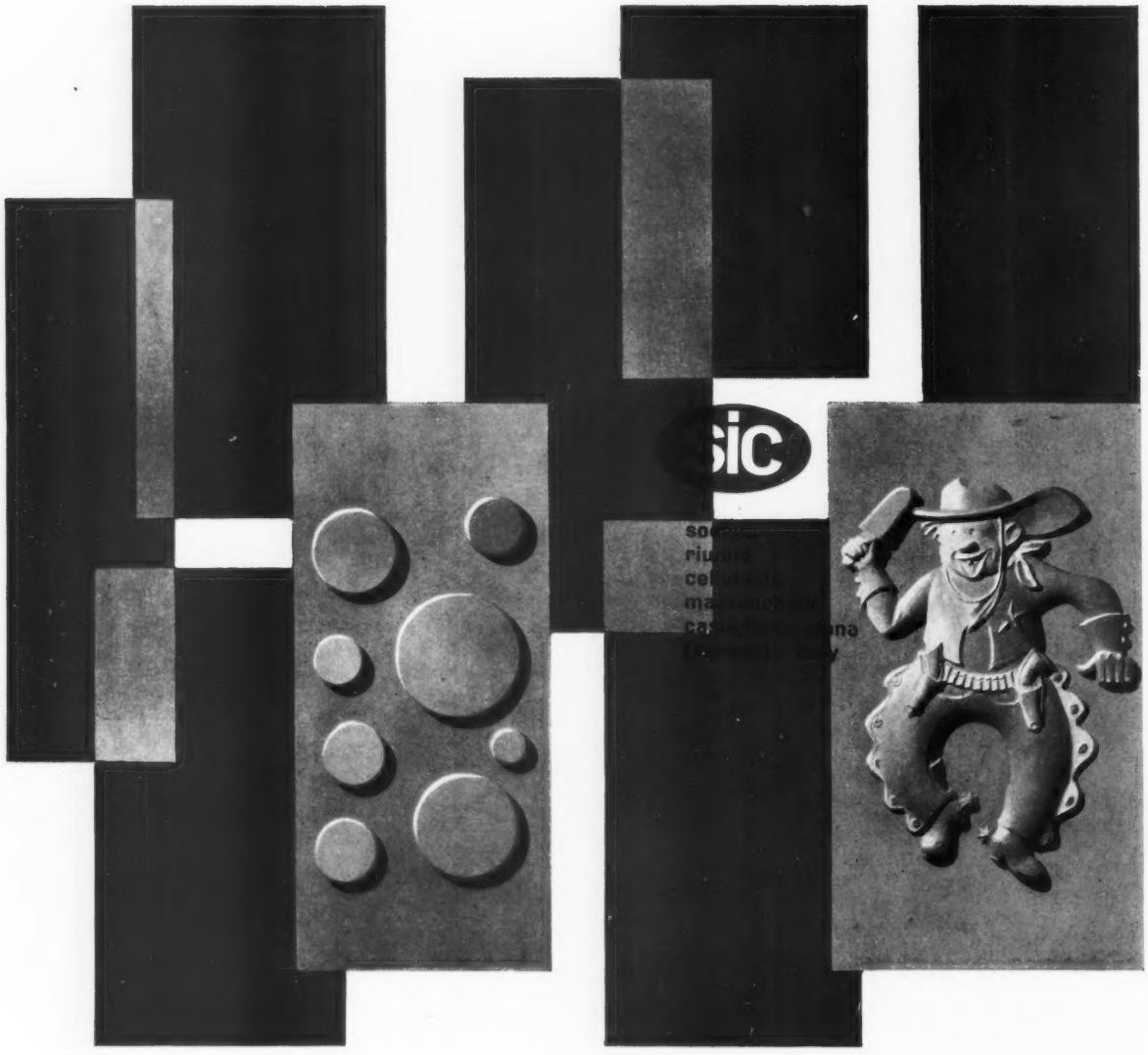

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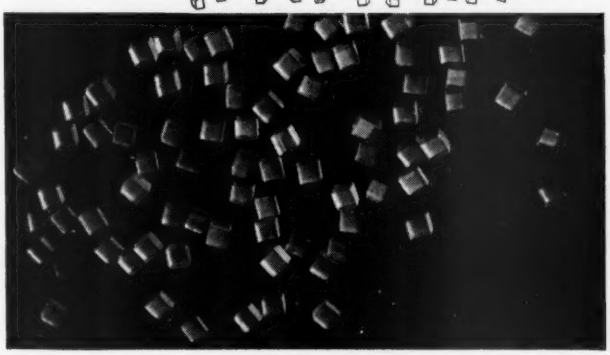

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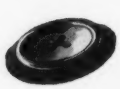

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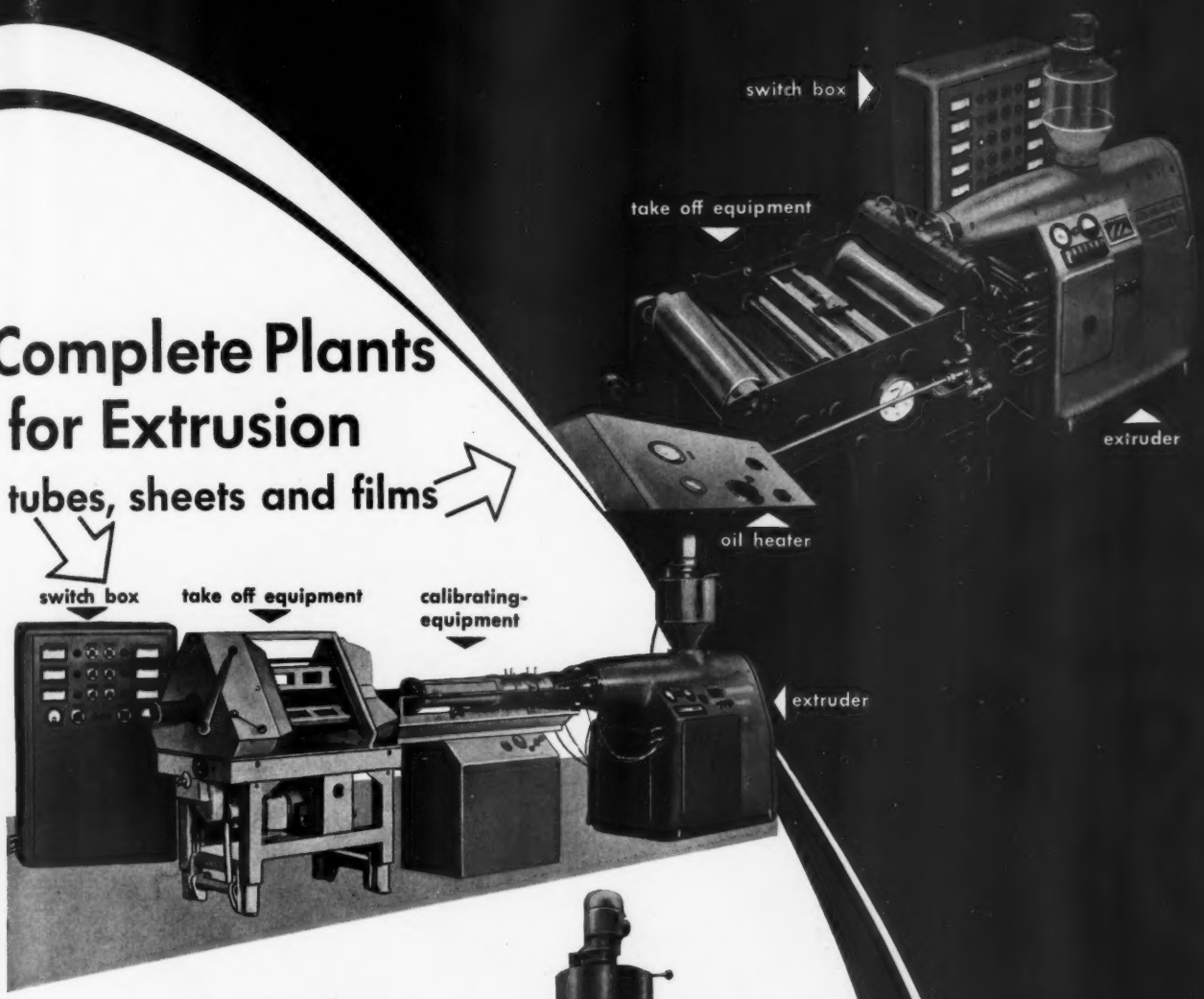

Extruder S 90 RGV
90 mm screw-diameter = 3.54 "

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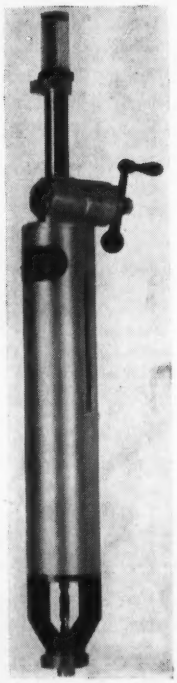
And Sisyphus
an huge round stone
did reel against
an hill . . . .

Poor old Sissy — condemned for ever to a job that got nowhere. Just a legend? Ah, but pause a moment, dear friends. Are there not Sissies in many a works trying this very day to bore half inch holes through tough metal with the wrong tool? *Alas, alack, there are indeed. Indeedy yes!*
The right tool? I am glad you asked me that! It is the Desoutter Pneumatic Rackfeed Drill which you *clamp* into position and operate simply by twiddling the small handle between the thumb and the forefinger. Send at once for exciting art photographs (Genuine students only).



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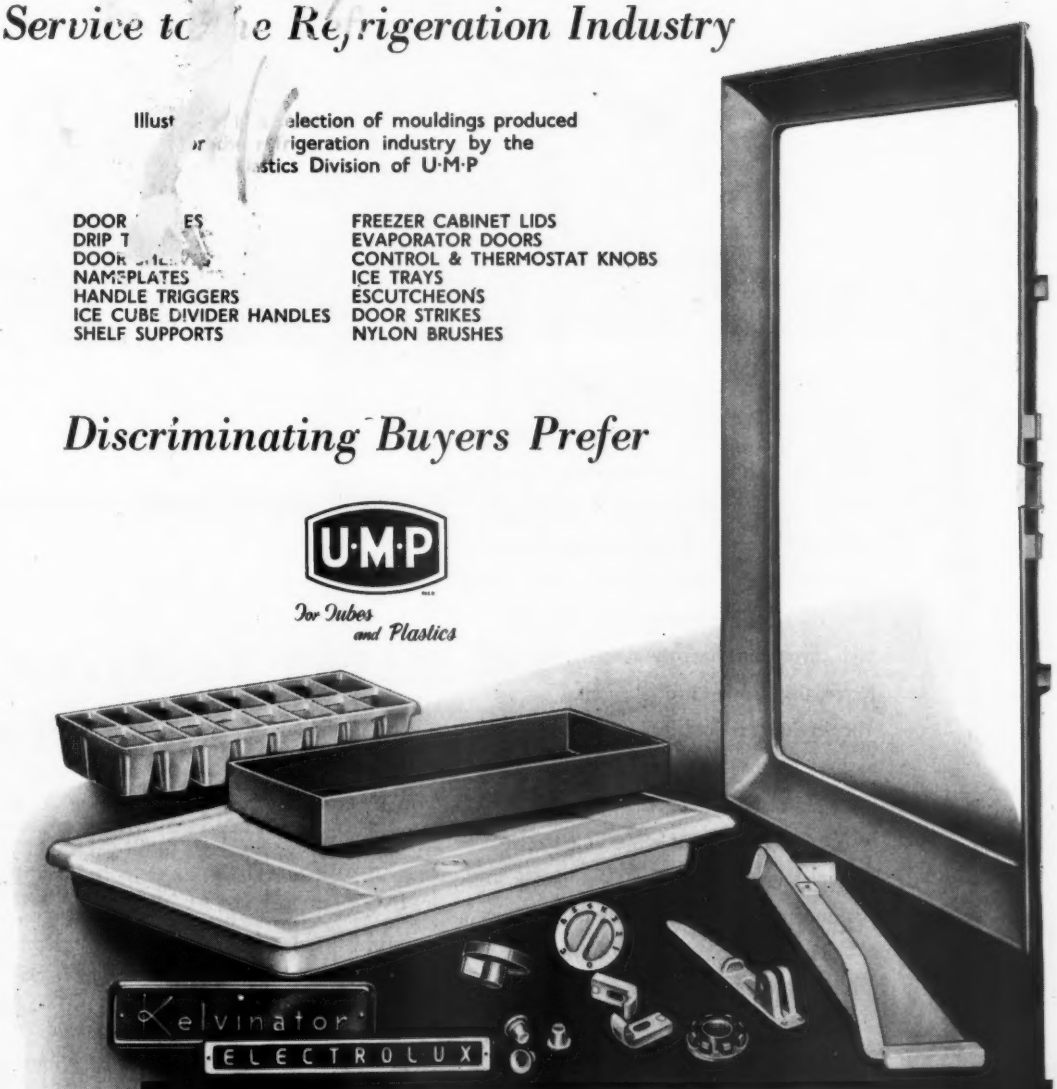

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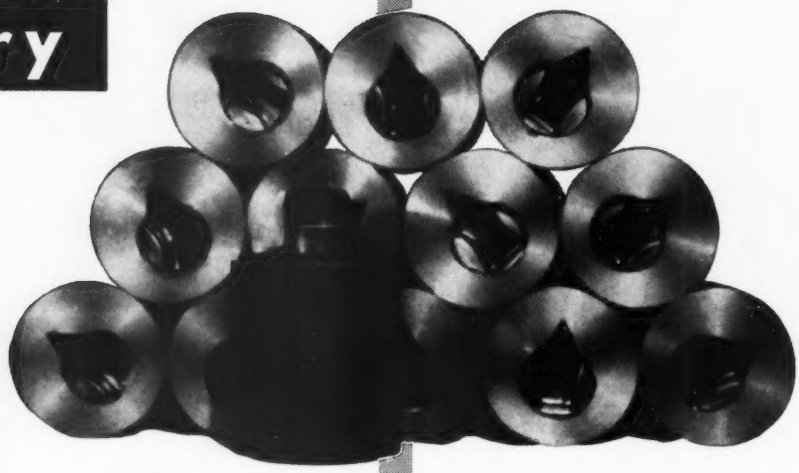
Hob-Knobbing with the Radio industry



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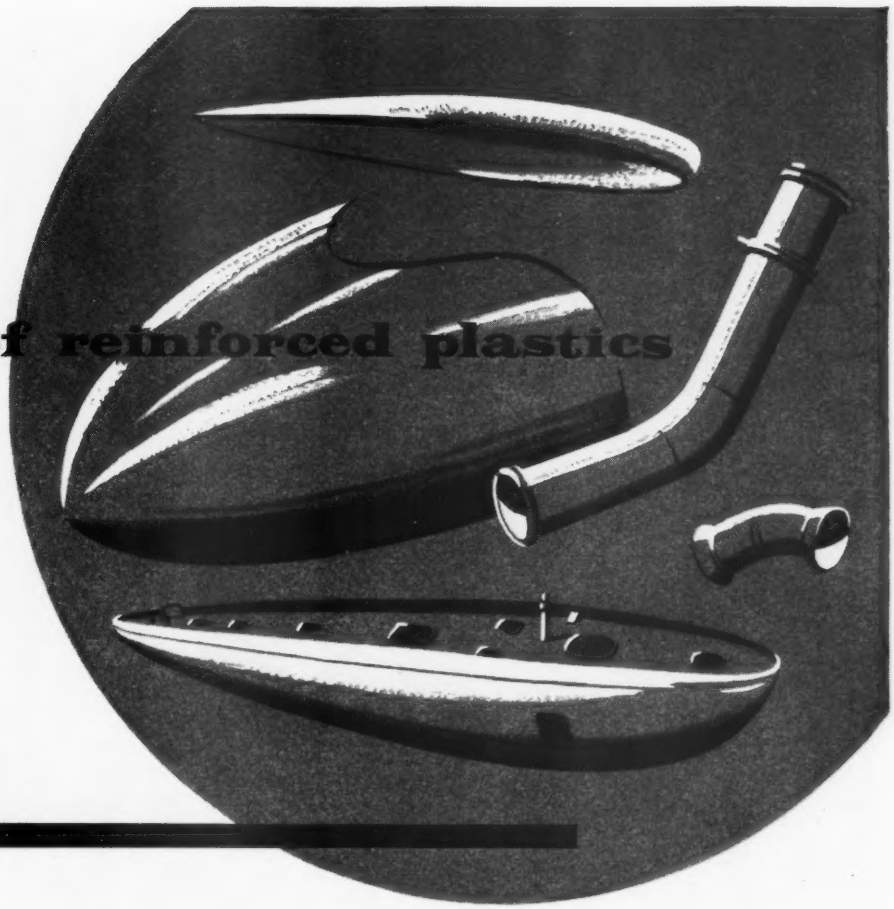

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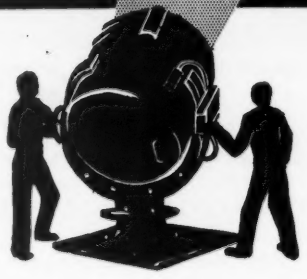

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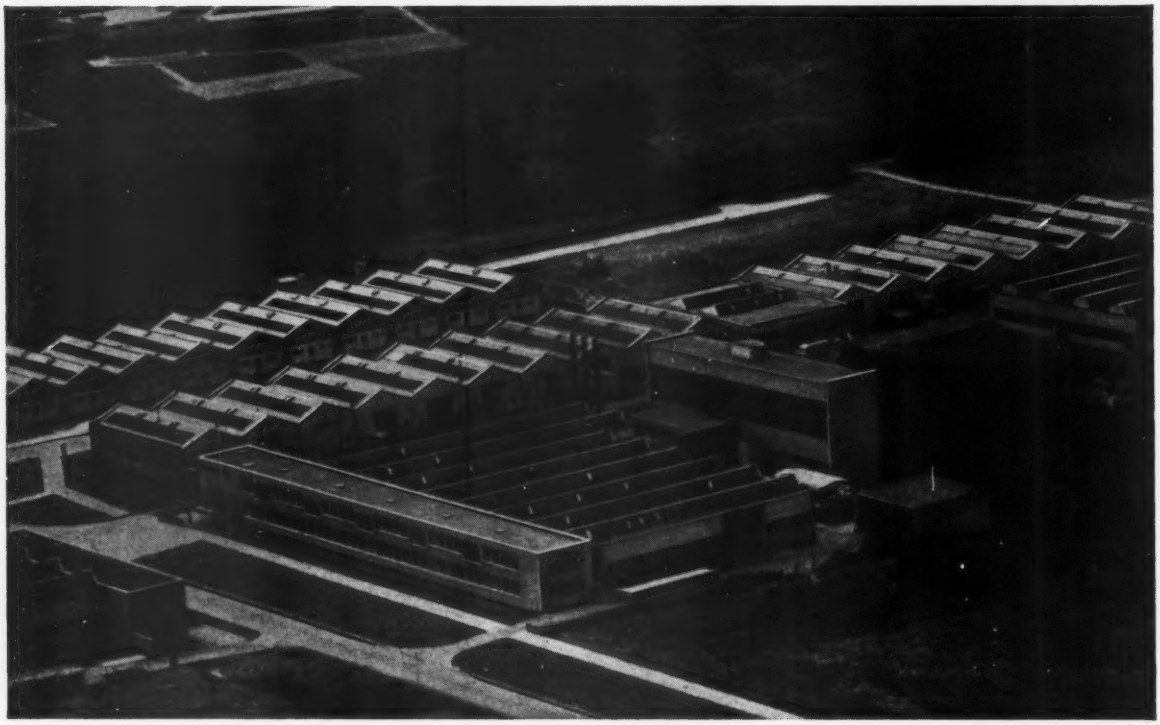

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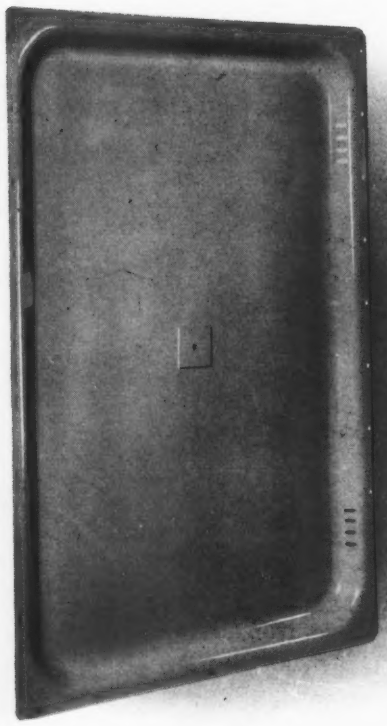

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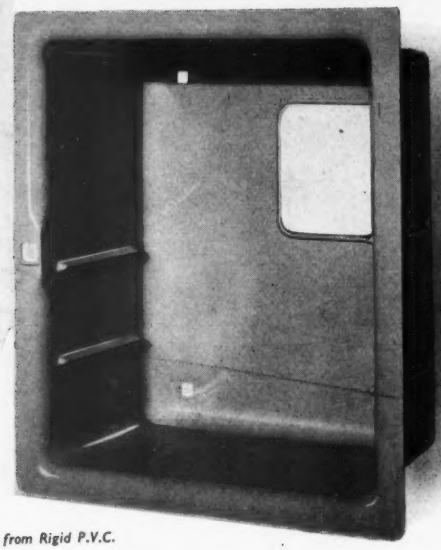

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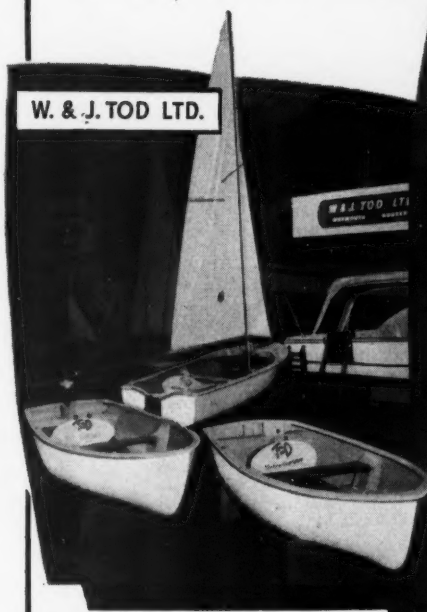

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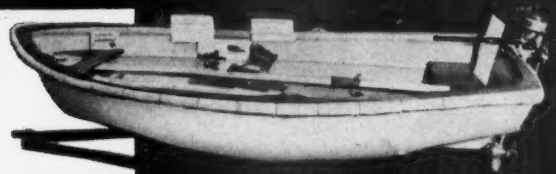

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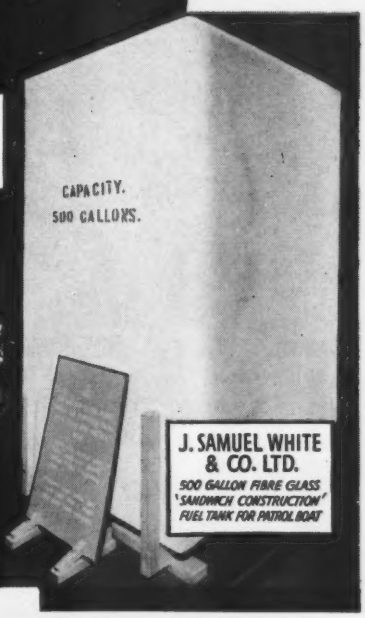

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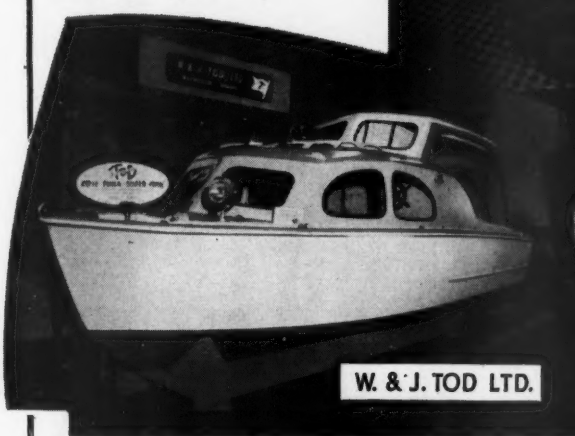

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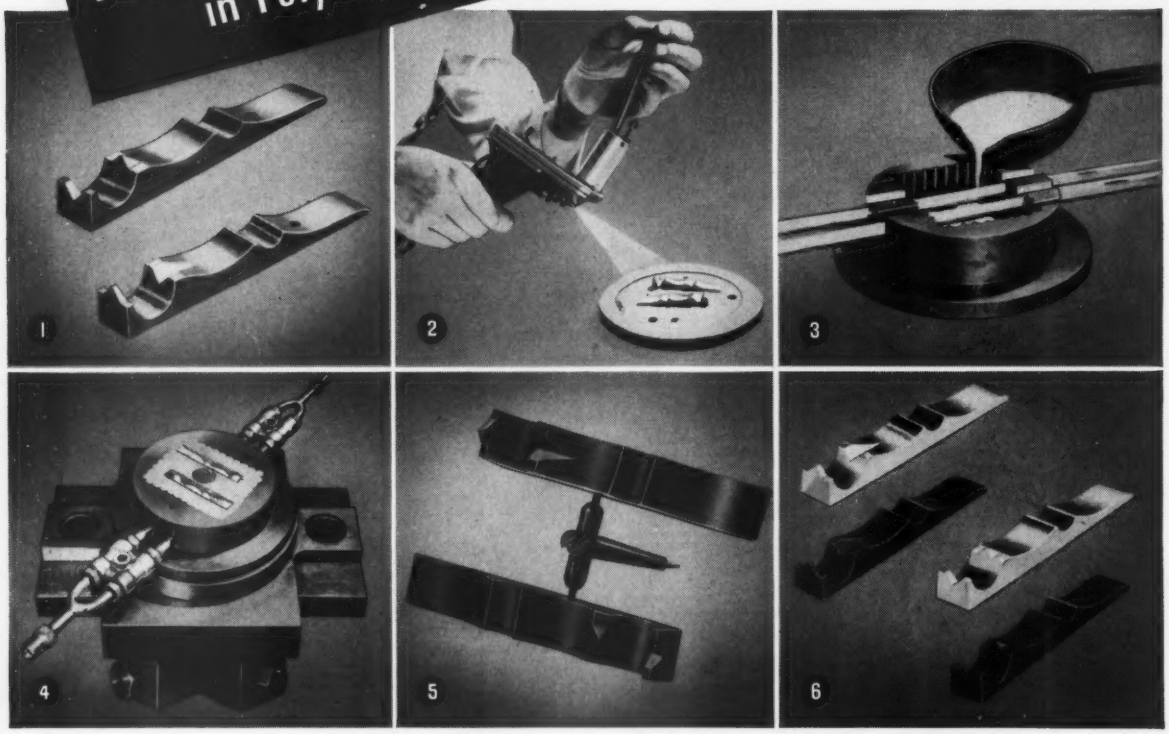

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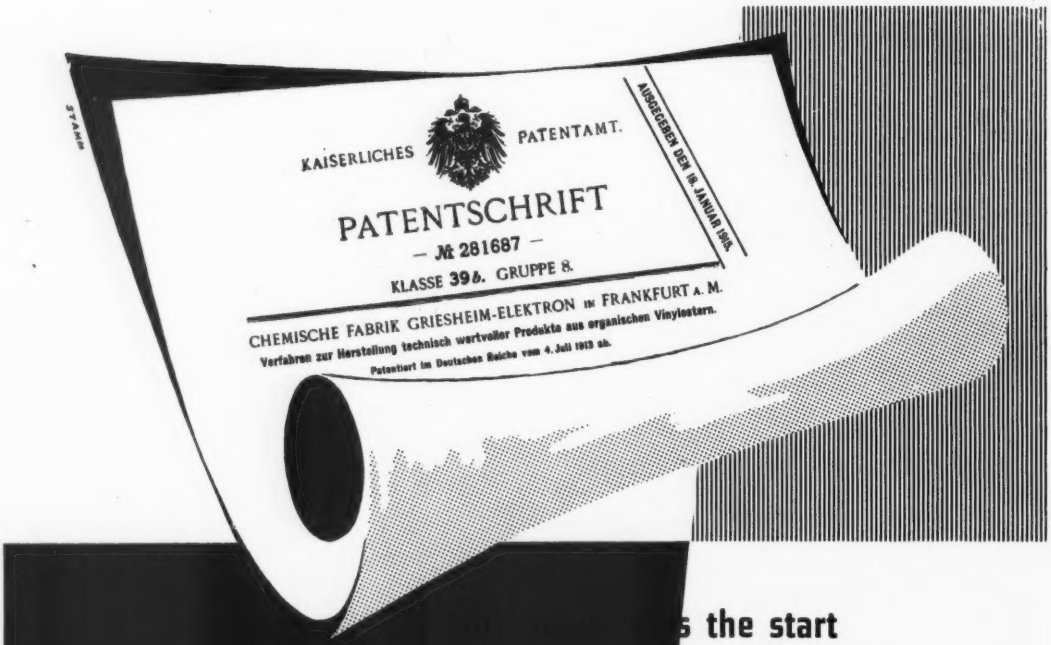
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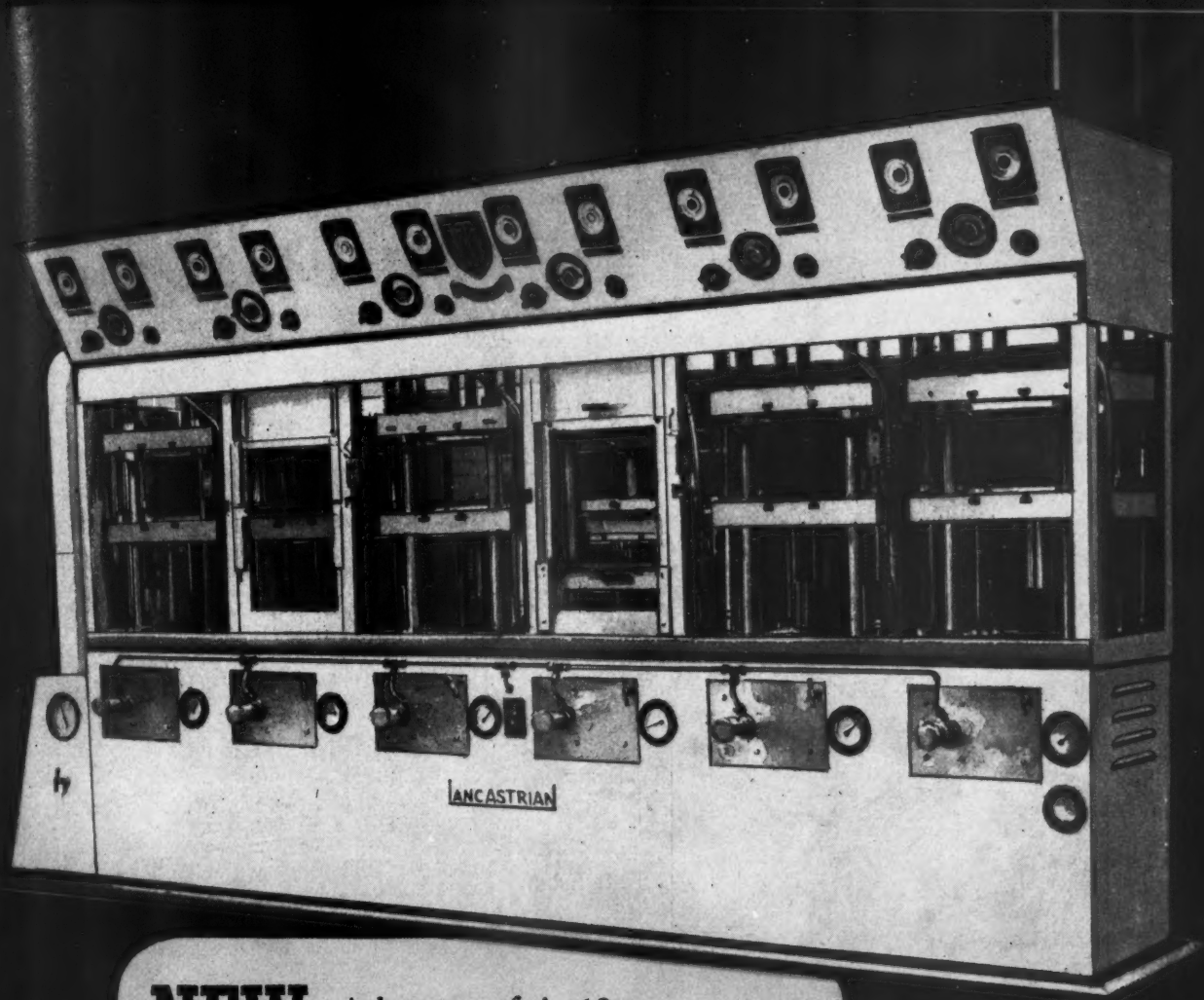

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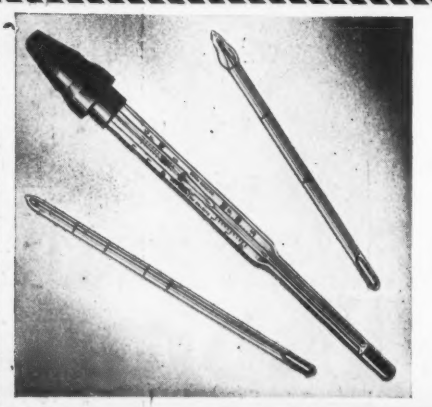

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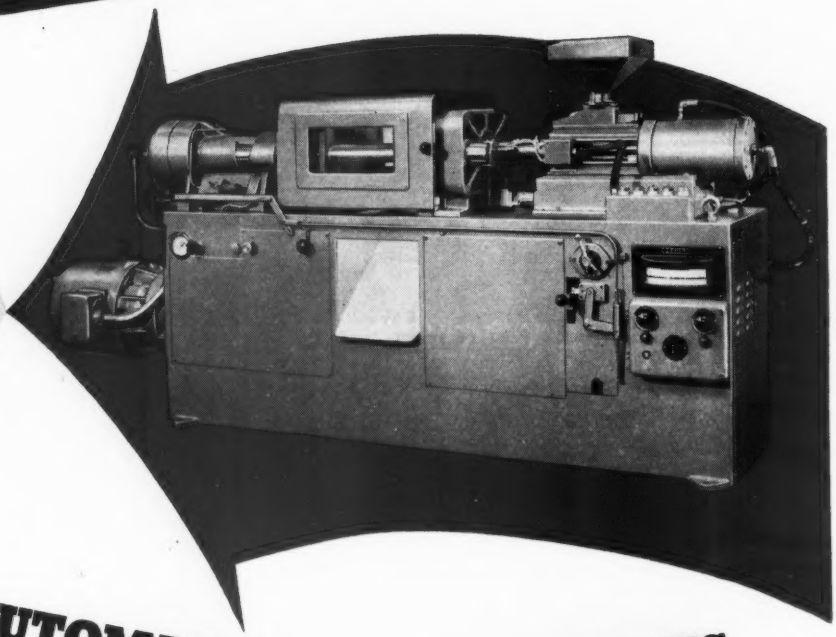

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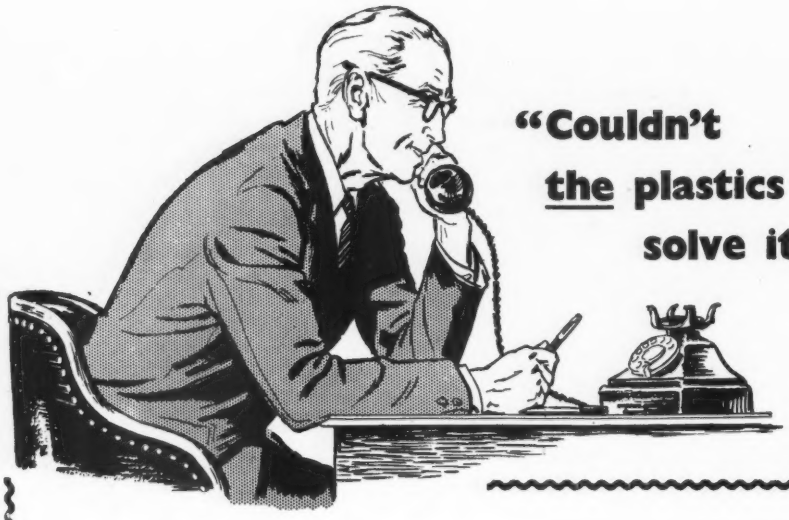

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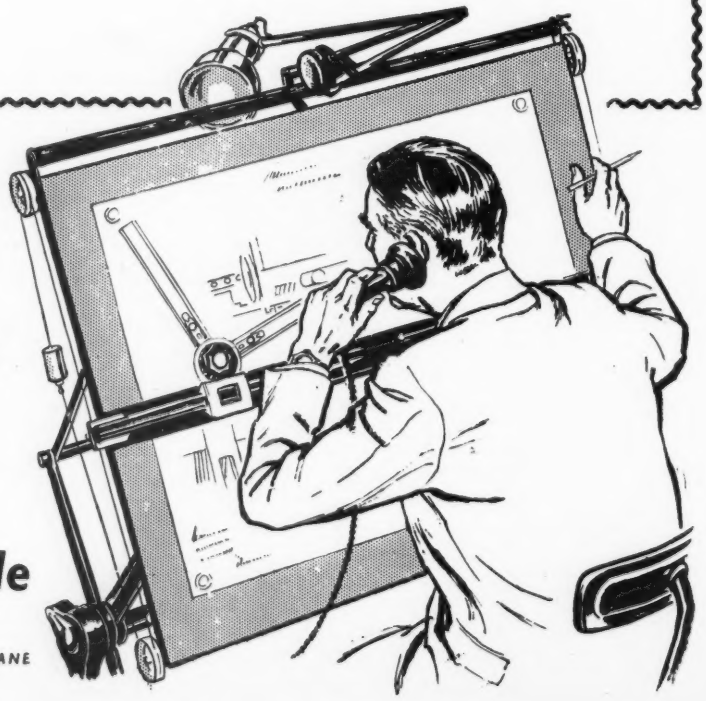

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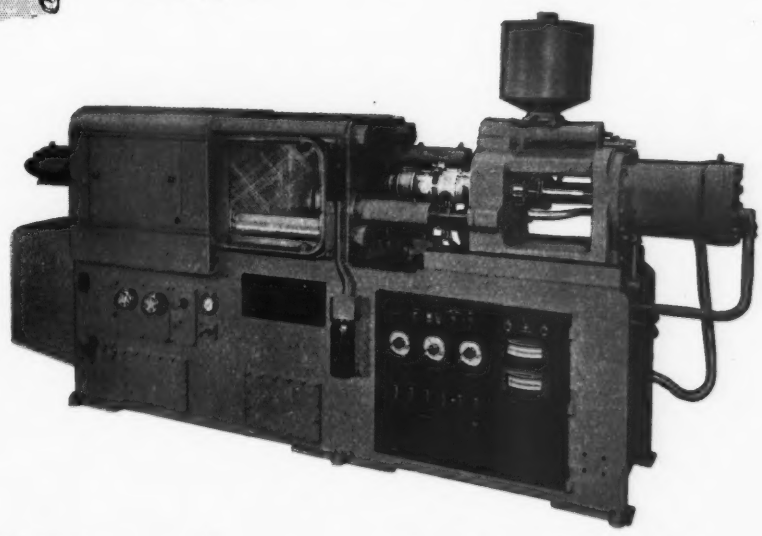

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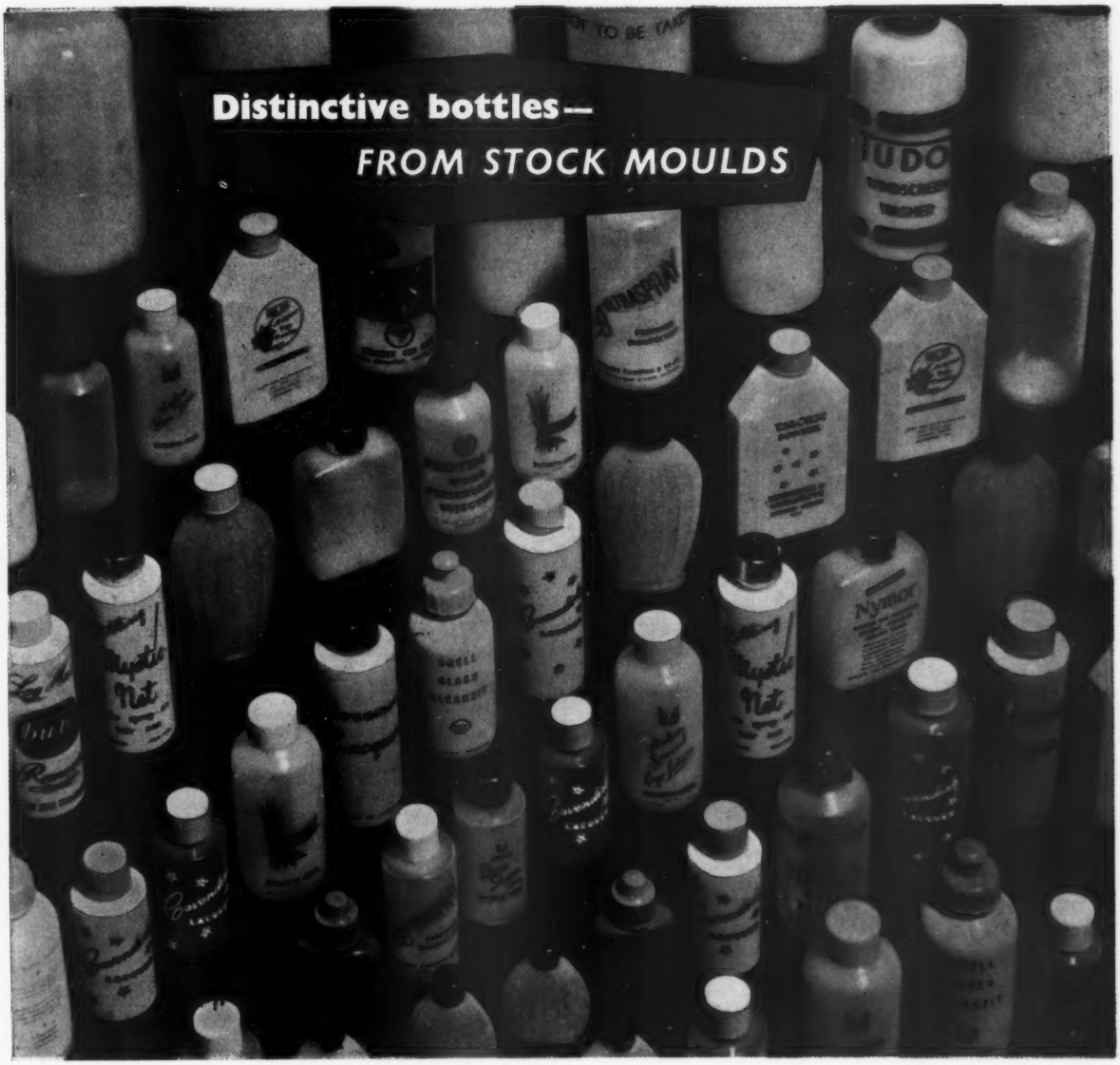

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POLYTHENE
CONTAINERS

These bottles have all been produced from stock moulds, and individuality is obtained by ringing the changes with colours and contrasting colour printing to give your product that tailor-made packaging look. If your product needs to be sprayed, puffed, poured through a small aperture, dispensed drop by drop or just packaged attractively, then Poly-Tainer have the answer to your problems. We make these unbreakable polythene containers in all shapes and sizes from 4 c.c. to 15-gallons, and the choice of colour is yours. Distinctive coloured Poly-Tainers from stock moulds means that your product can have an individually styled package **without any tool costs.** *Of course, we undertake custom styling on request.*

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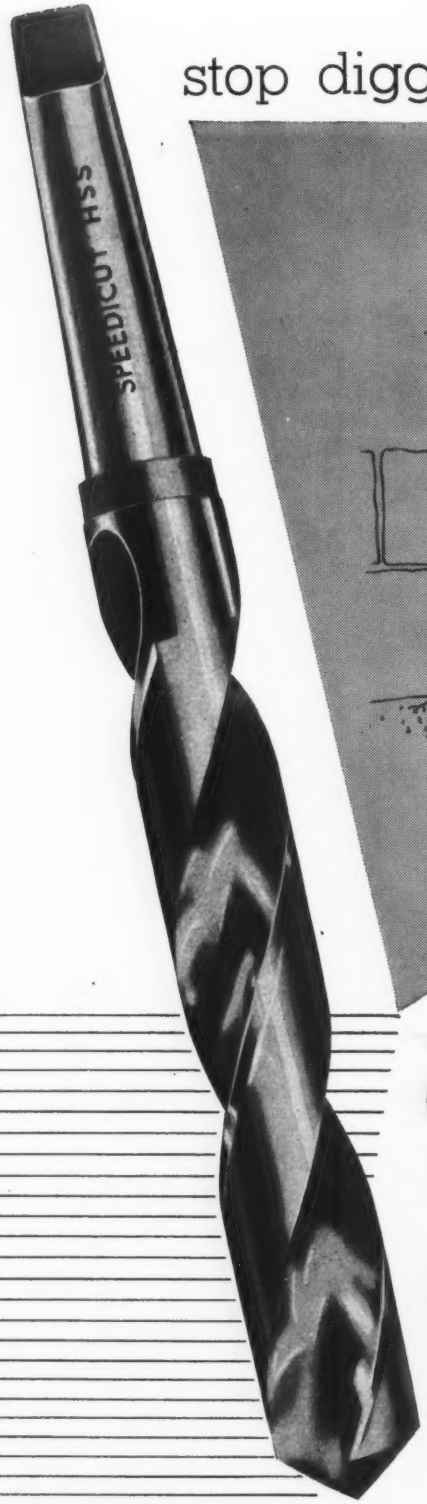

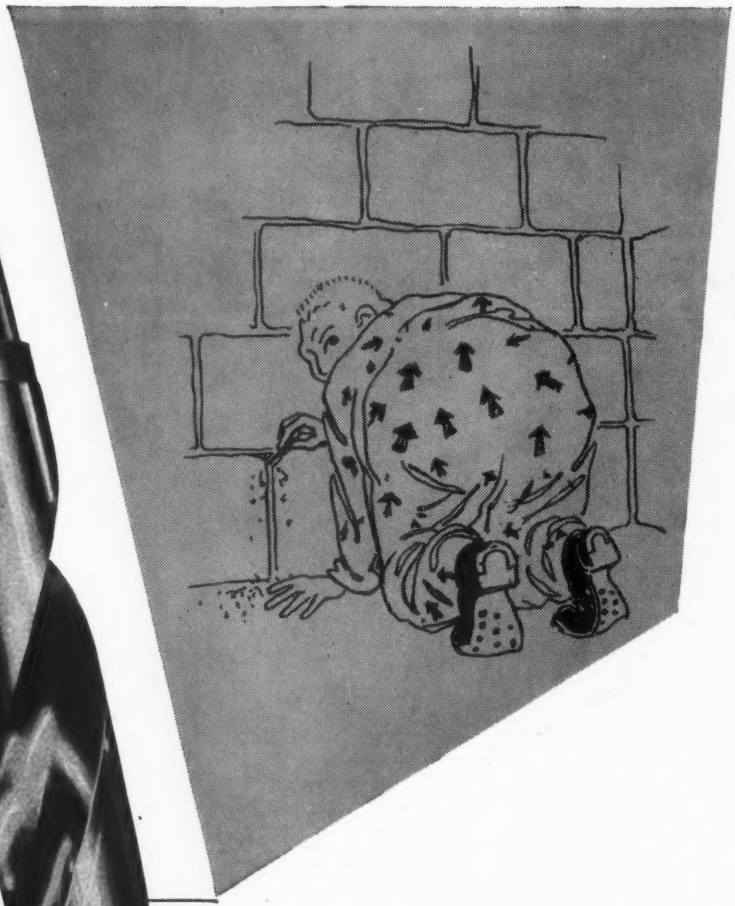

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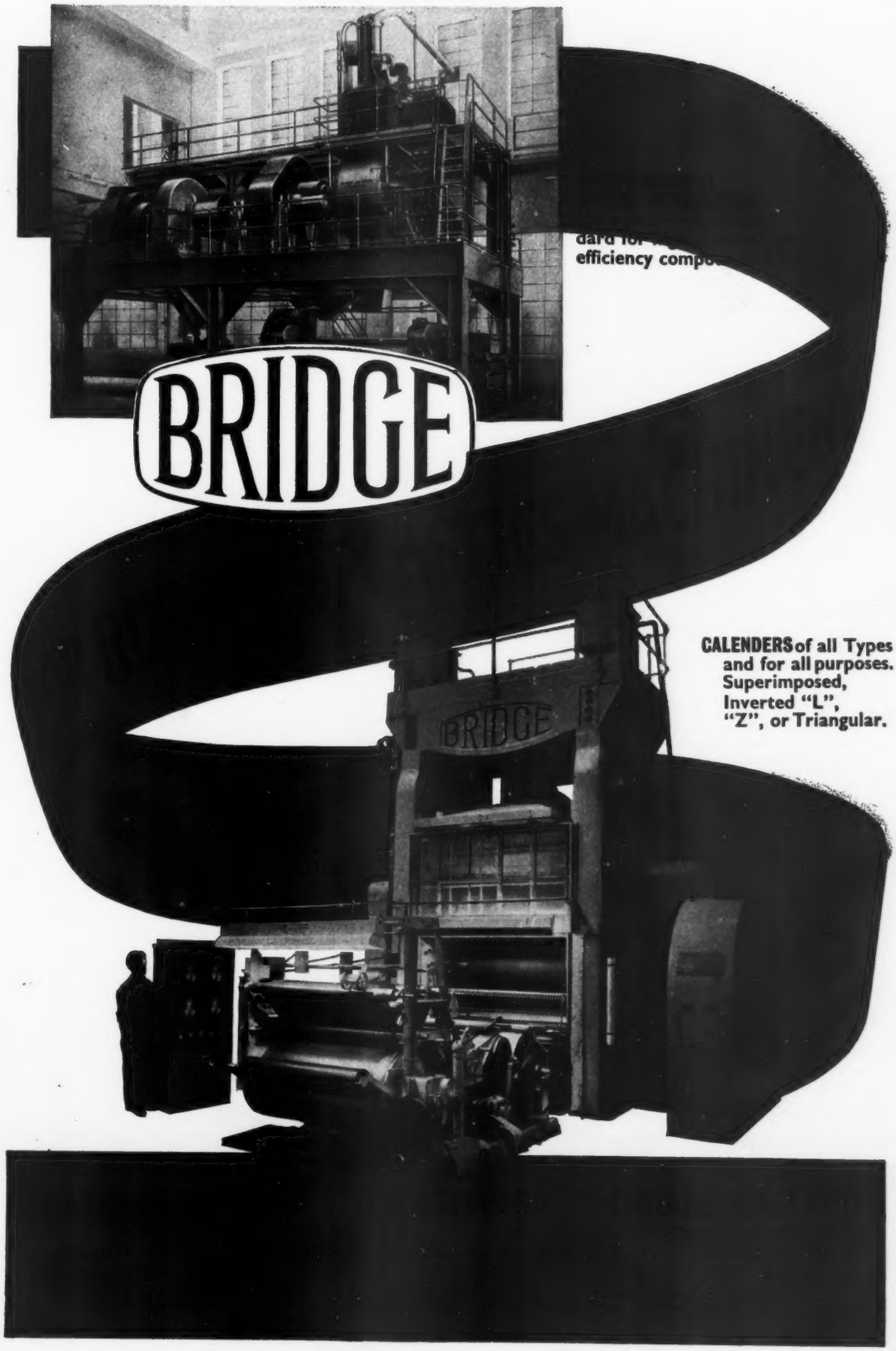
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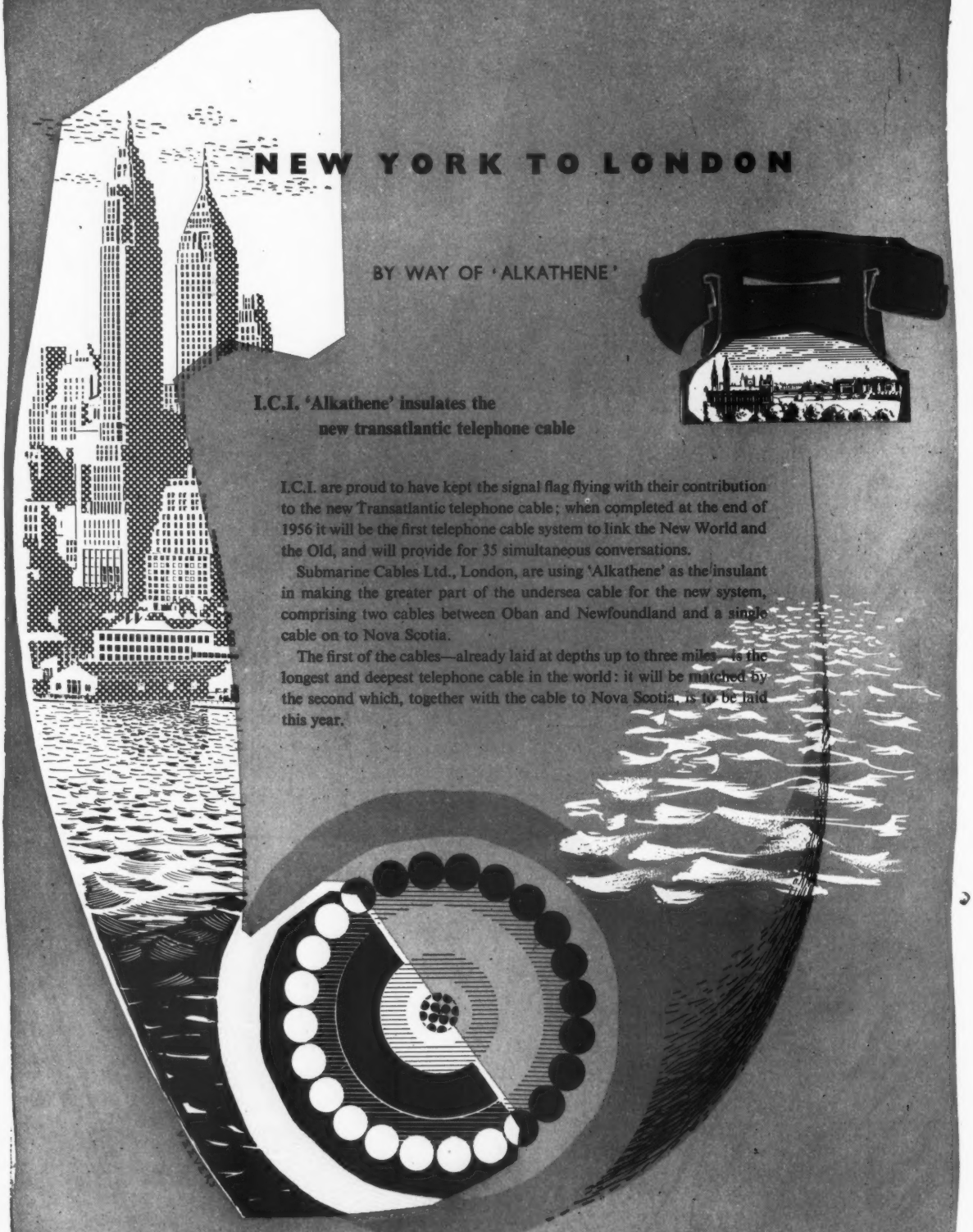

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IMPERIAL CHEMICAL INDUSTRIES LIMITED, LONDON, S.W.1

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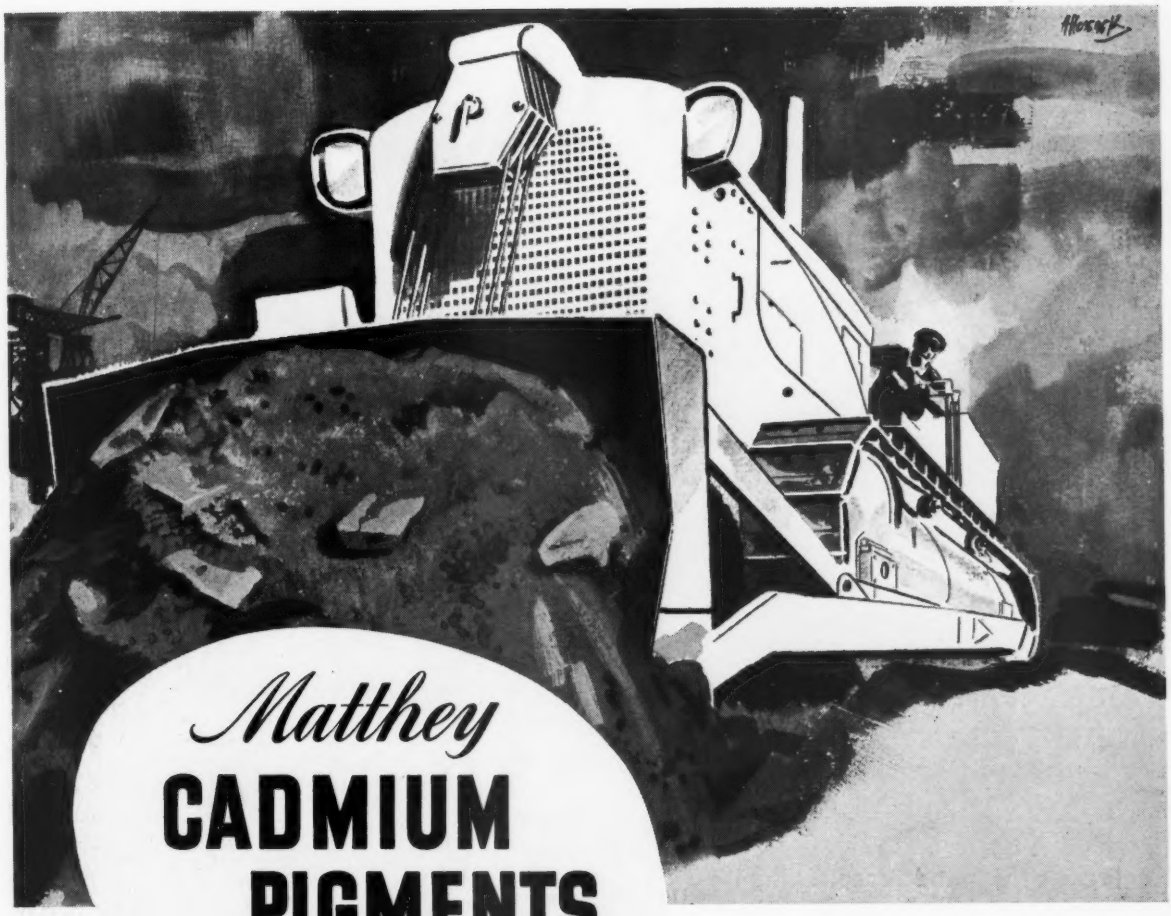

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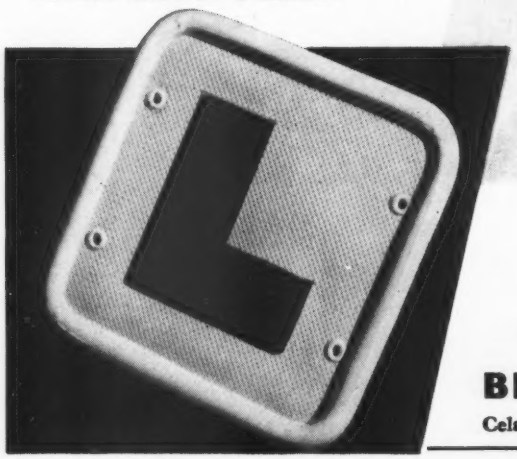

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Modulus of Elasticity in Tension	lb/in²	,, ,,	$3.5–4.5 \times 10^5$	$3.0–4.0 \times 10^5$
Flexural Strength	,,	ASTMD.790–49T	7000–8000	7000–9000
Deflection	ins	,, ,,	No failure	No failure
Izod Impact Strength	$\frac{1}{2} \times \frac{1}{4}$" bar ft.lb/in of notch	ASTMD.256–47T	0.7–1.0	0.9–1.3
Softening Point	°C	B.1493	86–90	85–89
Specific Gravity		,,	1.05	1.05

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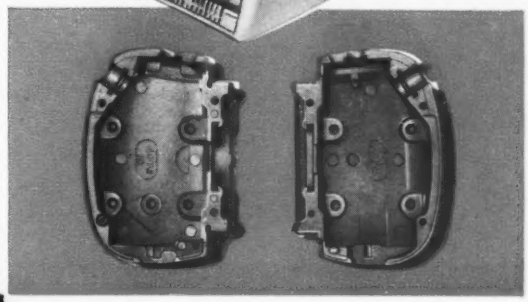

THE COMPONENTS

The two halves of the housing. These have to fit perfectly and, although made in two pairs at a time, any cover has to fit any case regardless of the impressions in which they are made. A very high quality outer finish is achieved from the precision moulds.

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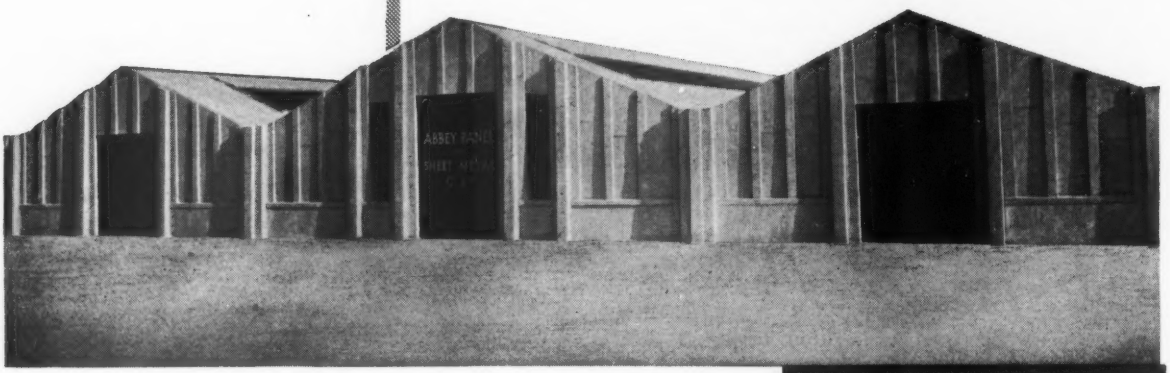

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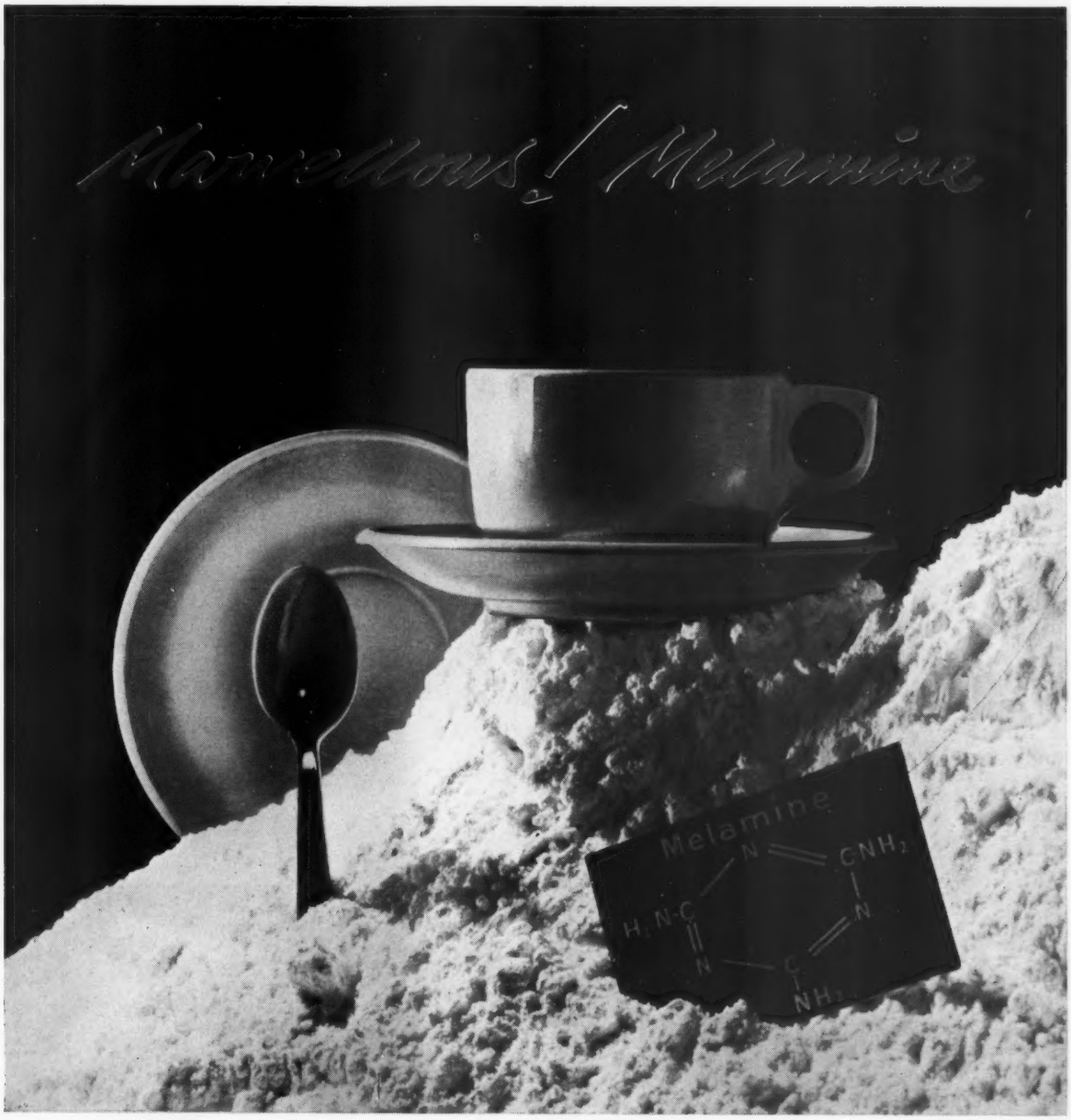
AP.211.56



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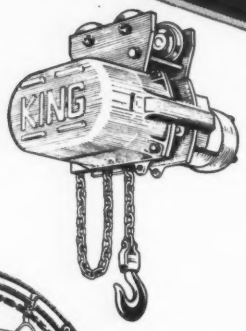

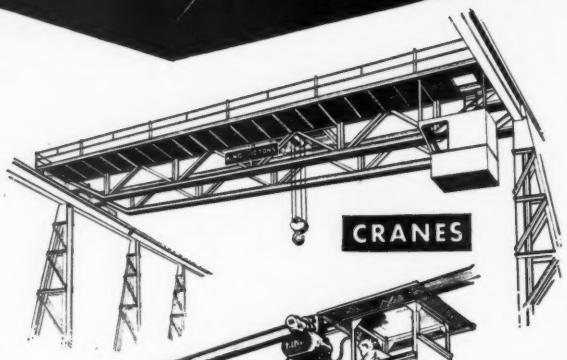

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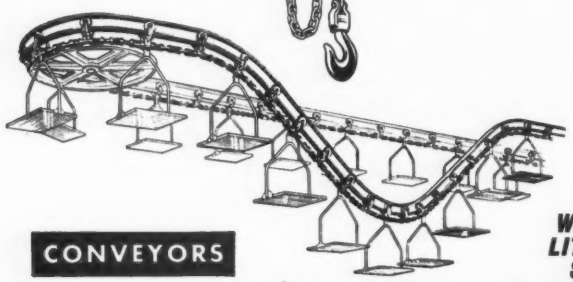

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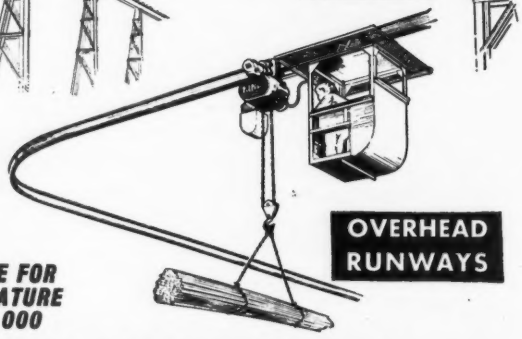

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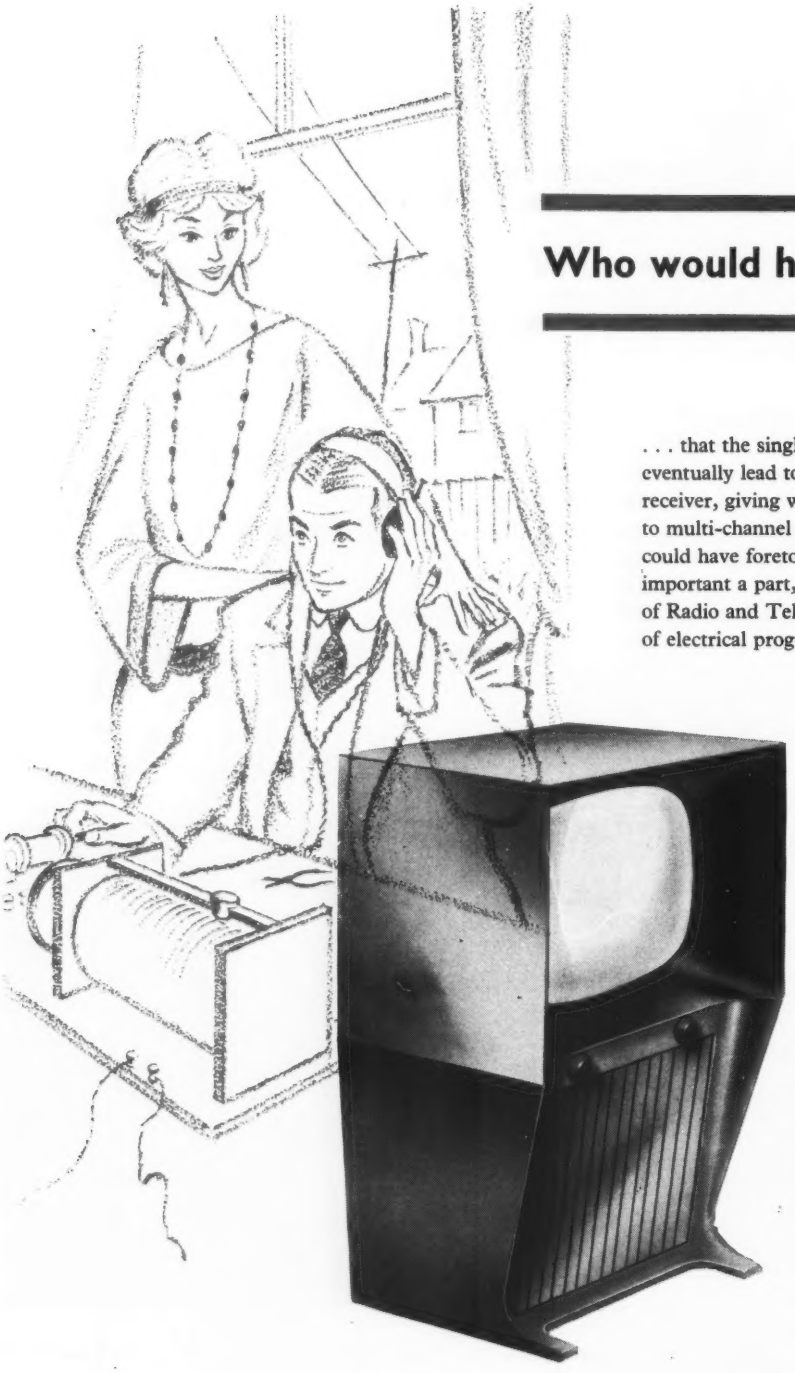
TGA PP1



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. . . that the single station 'crystal set' would eventually lead to the high-fidelity radio receiver, giving world-wide reception — and to multi-channel television? . . . and who could have foretold that plastics would play so important a part, not only in the development of Radio and Television but in every field of electrical progress?

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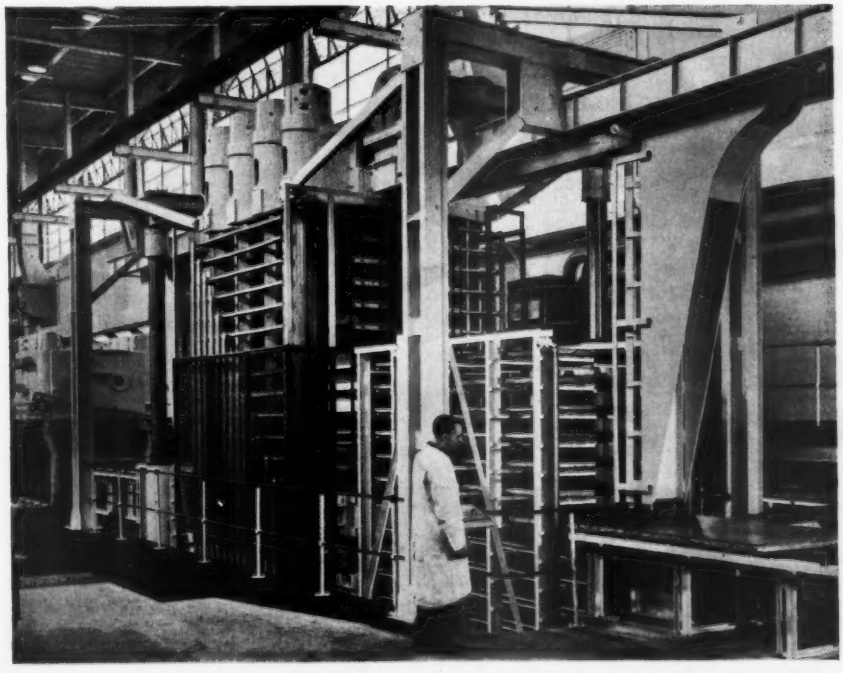
Telephone: TERminus 3636



6,100-ton press, to manufacture 10 ft. by 4 ft. sheets of Formica, at the Tynemouth Factory of De La Rue Ltd. Considerable economy in manufacturing costs will be effected by the use of this new press.

NP 39

something new

National Plastics TOOLMAKING DIVISION now makes moulds for 'the trade'

National Plastics experience, skill and reliability as mould makers is now available for the first time to moulder firms looking for toolmaking capacity.

Quite a few old timers at our Walthamstow factory have been making moulds for plastics for thirty five years. Building on a nucleus of this calibre our tool division has now so expanded its plant and skilled personnel that it can make moulds for the trade. This in addition to its normal toolmaking work for National Plastics customers, which is in no way affected.

facts

. . we made the mould, weighing twelve tons, for the only plastics television CONSOLE cabinet outside U.S.A.

our equipment includes FIVE Keller automatic copying machines.

we have made more radio cabinet moulds than any other tool making shop in Great Britain.

we have to our credit many highly ingenious automatic 'injection' moulds for moulding thermo-plastics.

NATIONAL PLASTICS TOOLS

NATIONAL PLASTICS (SALES) LTD. Sales Organisation for BRITISH MOULDED PLASTICS LTD.
Avenue Works, Walthamstow Avenue, London, E.4. *LARkswood 2323.*

Plastics

VOL. XXI. No. 224 MARCH-APRIL-MAY, 1956

EDITORIALS

Plastics and Rubber

ON March 22 we were delighted to accept an invitation by Dr. Cotton, Head of the National College of Rubber Technology, to attend the annual presentation of diplomas and prizes to successful students. The presentation was made by Mr. John H. Lord, executive director of Dunlops, and it was especially gratifying to us, in view of our editorial entitled "Plastics Education" in our February issue, to listen to his speech, and more specifically the latter part of it.

"I have one other special point to make," he said. "Rubber and plastics are both polymers and are already mixed up in many ways. Rubber will always play an important role in the economy of the world, but so will man-made plastics or polymers. They will, in some products, not only supplement the limited supplies of natural products, such as rubber, wood, and so on, but will provide an increasing range of new products to enhance our standard of living. If we, as a country, want to survive in this competitive world, we must excel in all these new developments. Technological education in both fields should be integrated and already is provided for in this college. But more has to be done.

"I believe I am right in saying our sponsoring body, the Ministry of Education, wishes to see more interest and activity by the plastics industry in this college. The rubber industry, itself already involved in the plastics industry, has the same wish. I hope the plastics industry will find the ways and means to show even more than it already has a practical and financial interest in students' courses and scholarships for this college.

"I urge young men with a scientific bent to take full advantage of the facilities for technological education and the financial aid available, and to enter a full-time course at this national college. I appeal to directors and managers in industry to release suitable men for sandwich courses, post-graduate courses and other courses which may be specially designed for the particular needs. I ask educationalists, whether in the public service, in universities, colleges, or in industry, to consider these courses in high polymers as suitable for general study for all entering upon a career."

This is broad-mindedness in action. Surely the time has now arrived for the whole of the plastics industry to crystallize its ideas and to express them.

Polythene and Polypropylene

WE live in fast-moving times. It is only 10 months ago that the news of the Ziegler harder polythene was made public at a Dusseldorf meeting we attended, and only six months ago since the fanfares blew around it at the German Plastics Exhibition. Its advent and that of the similar Philips type in America were rightly hailed as among the most important of technical advances in recent times because it takes the polythene story a stage farther and promises to consolidate more firmly the application of the polythenes in the chemical and engineering fields.

The first polythene which has reigned supreme since 1933 when I.C.I. discovered it, and which had also been manufactured abroad by some 13 holders of licences, had apparently received its first hard blow to the body. And if this does not now seem so serious as it first did, we must admit that not a few black spots of despondency made our high-minded scientific thoughts somewhat impure and were exceptionally difficult to filter from them. Were we to take no part in the broader field, other than to manufacture by licence from the Germans or the Americans?

It seems that our fears were groundless. On March 2, only six months after the Dusseldorf show, at a quiet cocktail party in a Piccadilly hotel, I.C.I., Ltd., also announced the production of a harder and more heat-resistant polythene, and showed numerous samples of piping, connections and other extruded, fabricated and moulded components. Furthermore, it was interesting to learn that the process remains the same, that is, it is still polythene made under high pressure. Indeed the examples shown were made on the same plant as the older variety, so that no great immediate changes can be presumed other than those necessary to supply the gradual new demand.

What will be the next step in this field? It is difficult to imagine yet harder polythenes, but new aims may follow the economics of petroleum cracking. All chemists who have studied petroleum chemistry know that ethylene and propylene (both gases are found in "cracked" oils) were first polymerised between 1880 and 1910 by a number of workers using metallic catalysts, silent electric discharges and similar activation methods. It is true that the polymers so formed were liquids not solids suitable as plastics; but they *were* polymers. The production of synthetic lubricating oils by such polymerisation was, at one time, a commercial enterprise.

It will be no great surprise therefore, to know that modern methods have resulted in polypropylene, a plastic which presumably resembles polythene closely. Both the German company, Hibernia, and the Italian, Montecatini are stated to be at least at the pilot-stage of manufacture. In some of the cracking processes, propylene is present in larger proportions than is ethylene, and it has always been stated to be the more easily polymerized. Obviously, I.C.I., Ltd., and indeed most countries with petro-chemical installations are also interested. Whether polypropylene is harder than polythene or not, the choice from the production point of view may prove to be an economic one.

Frozen Pipes and Boiled Bottles

EXCITING moves have also been noted in the application of plastics. The February cold spell, which created such havoc and loss as a result of burst iron pipes but which did not affect polythene piping in the few towns it had been installed, has resulted in the finest free advertisement ever achieved in the history of plastics.

While such ferociously cold spells are not common, it seems clear that in this country, where town councils, builders and

architects have never considered it necessary to insist on the better layout and protection of piping, some thought will now be given to methods of avoiding such recurring losses, the misery of flooding in winter and the resultant illnesses which nobody has mentioned yet in connection therewith. Town councils, water boards, architects, builders and even plumbers are now shouting "I told you so," and urging immediate action. Let us be thankful that some change has started. It is difficult to see, financially speaking, how inefficiently erected iron piping can be altered to the satisfaction of already harassed landlord, tenant or householder, but at least new houses can be sensibly fitted from now on.

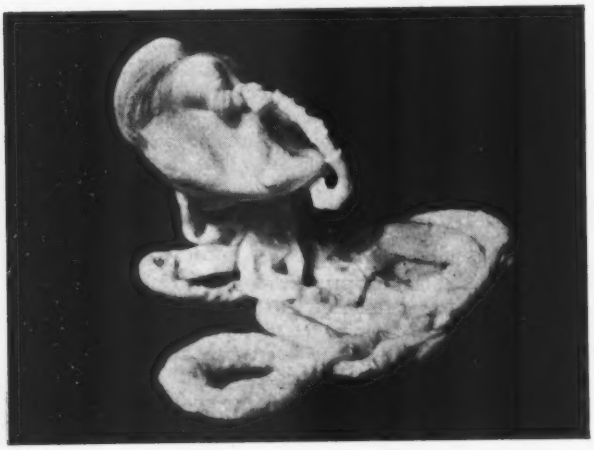
A new market for plastic bottles is now being investigated—probably the largest single and most important market of all—milk containers. The idea is obviously not new, and in 1938 we published the announcement that a company had been formed in the Midlands to manufacture them of cellulose acetate. The venture did not succeed, but today two types of bottle, one a milk feeding bottle for infants which is now on the market and the other an experimental milk bottle for house delivery, make their appearance. Both are of nylon, so that both can be sterilized. We have already published information, also from the same makers, Industrial Appliances, Ltd., of a nylon bottle made for the medical profession, so that technically all are launched for the same basic reason, sterilizability.

The milk delivery companies have always been interested in unbreakable types, witness the waxed cardboard type which did not prove very successful, and are no less interested in the new form. Quite apart from huge losses by breakages and "retention" by the public, the cost of carriage of glass is very high. Since a pint glass bottle weighs 17 ounces and a similar one in nylon would be 1½-2 ounces, and since also there are two types of lorry carrying 4,800 or 5,600 bottles, the saving in weight would be of the order of 1¾-2 tons per lorry! Saving could also be made in the type of crate, to say nothing of the very heavy labour of the personnel. The cost of a pint bottle in glass is fourpence. While it would seem obvious that the cost of the nylon bottle would be higher, it is the result of investigations of the advantages noted above that may at last tip the balance of final costs. Recent talks with costing personnel of one of the large delivery companies show that they know the technical advantages of plastic bottles and the cost point at which the change would come.

Moulding Powder and Shot

Art has no Frontiers

The wickedly cynical piece of sculpture shown below is by Fred Corbals, whose powerful work on the eight-ouncer (using high-impact polystyrene, and grafted at that) I have already praised. Doubtless it will strike a chord of memory, even if only an umbilical one, in its apparent relationship (note the meta-conchoidal structure of the genetic point, top left) to the work of Isambard Vov, second pastrymaker at Joe's Café, Canal Bridge, off the Harrow Road. There the semblance ends, for the sense of articulated movement throughout Fred's theme is almost overpowering in its intensity, and, if anything, owes allegiance only to the *Canardière* School of thought. As Cedric Ancred (one-time protégé of our own Miss Marsh) would have said if he had seen it—which he hasn't *yet* as it's *our* scoop—"There is a quality that appeals to me enormously, for the design is always consistent with the subject matter. In other words, the actual pattern is not something arbitrarily imposed on the subject, but an inevitable consequence of it. The result is complete integrity." Which is exactly the emotion we experience here. Fred first entitled his work "E = Mc," but later changed it to "Tiger, tiger, burning bright." He never explained why he did so and we respect his silence. But the same underlying attack on nepotism and the Positivism of Comte remains unflinching, uncompromising, deadly. Fred modestly asserts he owes all to the I.T.A. "Do it Yourself" feature (sponsor: Société Anonyme L'Hygiène Intime G.m.b.H., 13a (second floor, knock twice) Mozart Crescent, Shadwell Basin, London, E.). Maybe, but the spark *was* there.



* * *

Melamine Marches On

How bitterly I used to complain in the immediate post-war years, that a Tom Tiddler's Ground was being made of many plastic materials by the completely irresponsible who misused them in application, and produced mouldings of low quality and bad design. I even urged that raw material manufacturers should be strong-minded and clear-minded enough to place sanctions on their use and prohibit sales to those who looked on the public only as fair game. This was too strong meat at the time, I suppose, but many will remember the shocking results of not doing so. At long last one company has had the guts to safeguard its own interests and those of the public by this means, and equally sensibly, can show how all moulders can attain high quality production in a specific field, that of melamine moulding powder for table ware, which makes the problem the more readily soluble. In 1954 Mr. Charles Glassey, Managing Director of British Industrial Plastics, Ltd., conceived and insisted on the creation of a specification for its use which would lay down general principles of design and particular principles for moulding, inspection and testing. It has taken two years to make this specification. It is the work of a self-appointed committee of moulders that has laboured hard and with enthusiasm knowing that a big market for the best quality material was there to be attacked. The specification is now available and melamine table-ware has never before been made so well, and so consistently well. We can all congratulate Mr. Glassey on his initiative and the following members of the Committee for their unstinted and intensive co-operation: Mr. J. Butler (in the Chair) and Mr. H. A. Brooks, both of British Industrial Plastics, Ltd.; Mr. Davis, Streetly Manufacturing Co., Ltd.; Mr. J. Smiles, Ranton and Co., Ltd.; Mr. A. J. Burton, J. S. Peress, Ltd.; Mr. R. E. Brookes, Brookes and Adams, Ltd.; Mr. H. H. Smith, Roanoid Plastics, Ltd.; Dr. J. A. Hetherington, Halex, Ltd.; Mr. B. E. Terry, of E. K. Cole, Ltd., and a representative of British Artid Plastics, Ltd.

DOGSBODDY.

Commercial Vehicle Fleet uses Glass-reinforced Plastics

One of the biggest single contracts yet undertaken with glass-reinforced plastics is the fleet of fifty boxvans for Thomas Hedley & Co., Ltd. Some of the problems and fabricating techniques are described here.

(Left) Mould for roof section of Hedley van.

ONE of the first industries to display a more than lukewarm interest in glass-reinforced plastics was the commercial vehicle section of the motor industry. Its interest has been maintained and has gradually strengthened and rarely a month has gone by during the past two years without an announcement by one or another bodybuilder that glass-reinforced plastics were now being employed even if only to a limited extent. The Birmingham and Midland Omnibus Company have been in the forefront of these developments and have made extensive use of panels and components for their public transport vehicles. The Jensen Company has used this type of plastic material for commercial vehicles and one of the most notable developments was the construction of a 5-cwt. van by the Reliant Engineering Co., Ltd., of Tamworth, which was described in the October, 1954, issue of *Plastics*, pages 320 and 321.

It has been obvious for some time that the commercial vehicle building industry is, with the boat building industry, probably the most natural outlet for this group of plastics. This is due to a similarity in the circumstances governing both industries; in neither case is mass-production possible or even desirable, with the result that many of the companies concerned operate on a small scale and with a relatively low personnel list. Additionally, the commercial vehicle builder is at the moment forced to make use extensively of aluminium, much of which has to be panel-beaten. Panel-beating aluminium is a most costly method of fabricating a body. Since there is no hope at the moment of a reduction in the cost of panel-beating, the body builder would be foolish not to explore fully any alternative method which offers him freedom of manœuvre and lower cost.

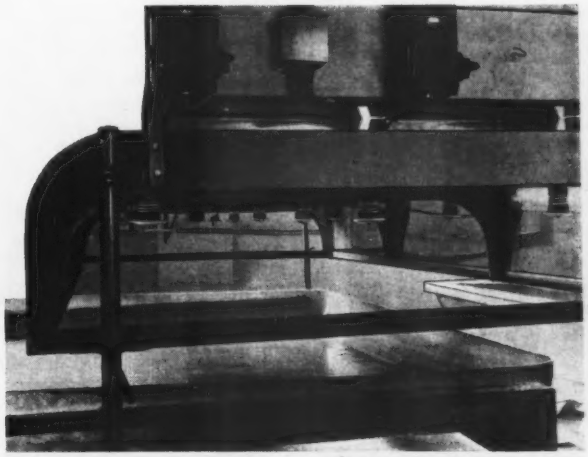
Up till now the pattern of development has been very similar in the case of each company entering this field. The first replacement of a metal part has always been of a complex curvature, and, generally speaking, glass-reinforced plastics have tended to be localized in their use in bonnets, wings and roof sections. The flat areas of the vehicle, have until now, remained in aluminium, or, in certain cases, plywood.

It has been felt by some that the use of two different materials, different both in appearance and behaviour, has mitigated against the wider use of plastics. This is not unnatural since there is an inevitable piebald appearance in a vehicle of the multi-constructional type.

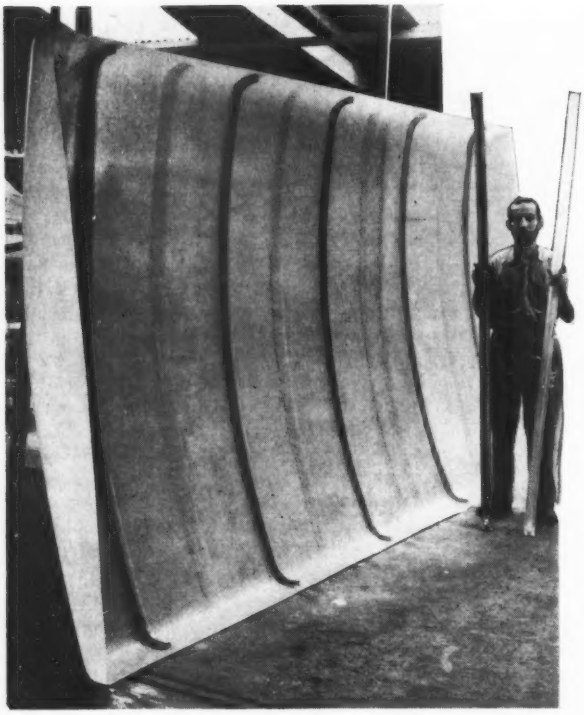
Large-scale Production

With the foregoing in mind, we were interested to see reported in *The Commercial Motor* on January 6, 1956, the much wider use of glass-reinforced plastics by Commercial Motors (Harrow), Ltd., Sherwood Road, South Harrow, Middlesex. This company has been active in experiments with glass-reinforced plastics for two years and has worked in close liaison with many of the raw material manufacturers. The technical staff have now reached the point where they

The gel coat has been applied and the first layer of cloth is impregnated with resin.



Drying hood in position over mould.



Roof section with stringers moulded-in as integral units. Operative on right holds pre-moulded stringer and mould.

feel able to undertake large-scale construction, with reproducible results; and amongst the several constructional jobs at present in progress is a series of fifty boxvan bodies for Thomas Hedley and Co., Ltd.

The construction details for this series will be of interest since they represent a break-away from the previously well-established pattern which localized the use of the glass-fibre plastics to the front ends of the vehicle. This break-away has been achieved by a close study of the technique involved of moulding, at contact pressure, flat panels measuring 8 ft by 4 ft. These large sheets are moulded with flanged edges so that when they are joined together to form the sides of the van, no filling strip is required and a non-broken surface is achieved.

Pre-colouring

A further development by Commercial Motors is the pre-colouring of these panels, in itself no mean achievement. A uniformity of colour dispersing throughout each panel has been satisfactorily achieved and successful colour matching between a whole range of panels has also been found possible.

Power saws trim edges of flat panels.

The secret of the successful moulding of such large panels lies in the use of positive heat which results in a total cycle in the mould of some two hours, compared with a cycle of some 12 hours for a moulding cured at room temperatures. A more rapid and more uniform cure appears to be possible by this method and the company is well able to maintain its scheduled output with a relatively small mould shop area available.

In addition to the flat panels, the roof section, canopy, and radius front skirts are moulded in glass fibre.

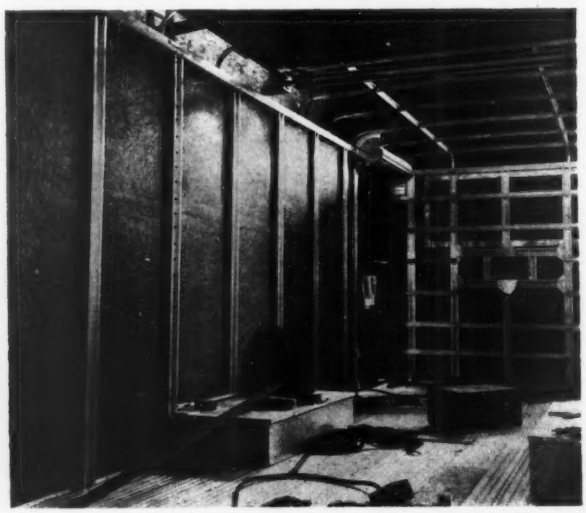
To the purely economic advantage resulting from this technique must be added the freedom from corrosion, the possibility of self-coloured materials and the considerable saving in weight resulting from a cutting down of the body framework. These features have encouraged Commercial Motors to plan for a very considerable development in the glass-fibre field and to allocate a complete section of the factory for development work.

Ageing of Polyester-glass Structures

A feature of these materials which has received little comment is the question of ageing. Accelerated ageing tests, are, as has been found before, likely to give rise to unsatisfactory results and none of the commercial vehicles built in this country has yet been on the road sufficiently long for a reliable estimate to be made as to their ageing properties. At the British Plastics Convention in June, 1955, Mr. Rees, of the Bristol Aeroplane Co., Ltd., announced that a comprehensive programme of fatigue testing was to be put in hand and the results of this will be keenly awaited. During the discussion which followed his paper, great emphasis was placed on the uselessness of any detailed fatigue investigation unless consistent laminates were commercially available. The word consistency was used in connection with the voids which are a frequent occurrence in the laminate with the " bucket and brush " technique. Unless the density of the laminate is consistent throughout, fatigue tests will obviously give unsatisfactory and very confusing results.

In the absence of reliable test data, therefore, we shall follow the developments at Commercial Motors (Harrow), Ltd. with great interest; the Hedley fleet of boxvans will be of special importance in evaluating the true working life of the glass-reinforced plastics in their present form.

We acknowledge the ready assistance of the management and staff of Commercial Motors (Harrow), Ltd., in the preparation of these notes, and photographic facilities.



Typical van under construction.

The Nylon Milk Bottle

Manufacture of the polythene bottle by the blow-moulding technique has resulted in many new applications for plastics in packaging. With the adaptation of nylon to this method of bottle manufacture, many new outlets are now possible, particularly where sterilization is an important factor.

ALTHOUGH by no means limited to polythene, the plastics bottle field has, nevertheless, during its rapid expansion in post-war years, been concentrated mainly upon polythene.

A relatively small number of plastics bottles have been produced in many other materials, although some quantities have been made in p.v.c.

There are many reasons for the concentration having been focused upon polythene practically to the exclusion of other materials, but in the main they fall into the following categories:—

(a) The ready availability of polythene.
(b) The various properties of polythene, particularly its non-toxicity.
(c) The lack of materials available to manufacturers in suitable grades for bottle manufacture.
(d) The lack of suitable machinery capable of high-speed production in some of the newer materials which are now becoming available.

Despite all its virtues, however, there are many fields in which either it has not been possible to introduce polythene for bottles or, alternatively, such introduction has been severely limited, due to the inherent limitations of the material itself. Generally, these limitations fall into one or more of the following categories: (i) The opaqueness of polythene, which is naturally translucent. (ii) The relatively low softening point of the material, bearing in mind that sterilization is sometimes desirable or essential. (iii) The permeation of, and absorption by, polythene containers of many of the substances commonly used.

It is, therefore, of immense importance to industry generally, and the medical field in particular, that plastics bottles are now being produced in materials that are transparent, sterilizable (up to 140° C.), unbreakable and non-toxic, and this will undoubtedly give an unprecedented boost to the sales of plastics bottles throughout the world.

Pioneers in these new containers, which are known as Nylo-Tainers, are E. Shipton and Co., Ltd., who distribute their products through Industrial Appliances, Ltd.

The cosmetics industry are quick to realize the enormous potentialities of this new material, which gives them at last an unbreakable plastics container in which high-quality perfumes can be stored without fear of deterioration or permeation. Industrial Appliances are currently supplying bottles from 3 c.c. upwards and have announced that practically the whole of the Poly-Tainer range of polythene bottles is available in the new transparent Nylo-Tainer range.

Considerable development work is now proceeding on Aerosol containers, as a nylon bottle can, when suitably designed, withstand the internal pressures encountered.

In the medical field there is no doubt that blood plasma will eventually be packed in Nylo-Tainers, and they would obviously be very suitable for much of the laboratory ware.

Perhaps one of the most outstanding developments, and one which will make its impact felt upon the market very shortly, is the introduction of Nylo-Tainer milk bottles. In designing the milk bottle to suit the new material, care was taken to ensure that the same base diameter was maintained, thus allowing for existing filling machinery to be used without any extensive alteration. Furthermore, the cap diameter was maintained, so that the same caps as are now used upon the glass bottles could directly be used on the plastics bottles without alteration.

Fig. 1. On the left is the nylon milk bottle; a 93% saving in weight is effected in comparision with the glass bottle on the right.

Bearing in mind the substantial reduction in wall thickness of the plastics milk bottle when compared with the glass one shown on the right of Fig. 1, it was possible to substantially reduce the height of the plastics bottle and yet allow for its capacity to be identical to that of the larger glass one. As the plastics milk bottle weighs only one-fourteenth of the weight of the glass bottle, there will, quite apart from the saving of breakages, be a substantial saving in transportation costs.

Nylon is considerably dearer than most other plastic materials, but the introduction of high-speed automatic production machinery has enabled Nylo-Tainers to be produced at prices which will permit very widespread application.

British Plastics Federation

21st ANNUAL LUNCHEON

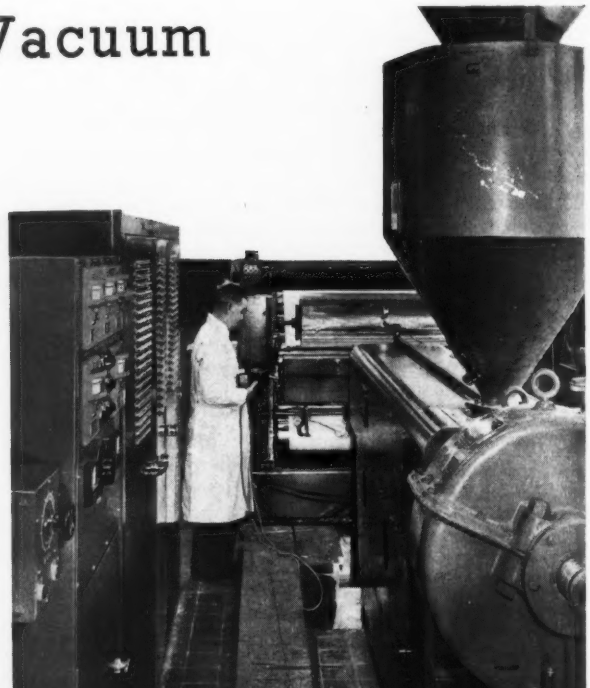
ON April 25th, at the Savoy Hotel, the British Plastics Federation held its annual luncheon. The chairman, Mr. C. C. Last, delivered a vigorous and heartening speech on the growth and future prospects of our industry, which had climbed in production in 1955 to 274,000 tons (exports were 80,000 tons); exports in machinery totalled nearly £2,000,000. He also spoke proudly of the fact that while the general price level of industrial materials had risen by one half, that of plastics had risen by less than one quarter. The principal guest, Lord Mancroft, joint Parliamentary Under-Secretary for Home Affairs and Spokesman for the Board of Trade in the House of Lords, replied to the toast to the guests with one of the most delightfully humorous talks we have yet listened to and declared his pleasure at the health and vigour of the plastics industry.

Over 350 members and guests attended.

(L. to R.) Lord Mancroft, Mr. C. C. Last, Mr. M. D. Curwen.

Extruded Sheet for Vacuum Forming

The first unit installed in Great Britain for the extrusion of polystyrene sheet recently came into production at the works of Saro Laminated Wood Products, Ltd. This unit which is of American manufacture can produce, it is estimated, up to 800 tons of sheet per year at a comparatively low cost. The potential market to be served is the progressive vacuum forming industry where such quantities of sheet will be a welcome addition to existing supplies.



(Right) A view of the N.R.M. extruder, laminating rolls and temperature control panel.

THE increasing popularity of vacuum forming has brought in its wake a greater demand for sheet materials and the prospects within the next year or two of an even greater increase in its use appears to be certain. To help fulfil this increasing demand Saro Laminated Wood Products, Ltd., Whippingham, East Cowes, Isle of Wight, have installed the first sheet extruding unit to go into production in this country. Although it has been known for some years that sheet materials can be successfully extruded and in fact in the U.S.A. a considerable number of companies produce sheet by this method, it is only within the last year that the markets for sheet materials have warranted the use of extruders with their high production rates.

First in this field are Saro using an American N.R.M. extruder and sheeting equipment and producing high-impact polystyrene sheet from Styron 475 moulding powder.

Equipment

The equipment which is manufactured by the National Rubber Machinery Co., of Akron, Ohio, consists basically of an extruder, sheeting polishing and laminating rolls, draw rolls and guillotine. The extruder (5) has a 4½-in. screw diameter with an effective cylinder and screw length 20 times that of their respective diameters. The barrel is divided into five zones for heating purposes each zone having separate pre-set temperature controls (6). The screw is also designed for water cooling should it be necessary and is driven by a 50 h.p. electric motor with fully variable speed control.

The sheeting die, which in this case will produce sheet of up to 48 in. in width, is again divided into five zones for temperature control. Zone temperatures are controlled from a similar, but separate, control panel (7) to that used for the barrel heating. Attached to each zone is a pressure gauge (8) which, in combination with the temperature readings, provides a record of the conditions prevailing for the satisfactory production both in quality and quantity of sheet material.

Immediately adjacent to the die and fed directly from the die are the polishing rolls (10). These rolls which besides having a finely polished surface are also chromium plated, perform the dual purpose of gauging and surface polishing the sheet, in addition, where a gloss finish is required, they provide the pressure necessary for laminating the film. The rolls themselves are heated by water, each roll having its own automatic temperature control (11). The drive for the rolls is supplied by electric motor with an infinitely variable speed control.

As the sheet leaves the bottom roll it is supported by a multi-roll conveyor and led up to the draw-rolls (13). While on the conveyor cooling takes place enabling the sheet to be handled comfortably by the rubber rolls which feed to the edge-trimming knives (14) and thence, again supported by roller conveyor to the guillotine unit (15).

The guillotine itself is operated automatically by a servo mechanism (16) actuated by the sheet as it reaches a predetermined length. The sheet is held momentarily at the guillotine while the cutting is completed and immediately on release the stacking mechanism goes into operation. It will be apparent that as extrusion is a continuous process it is imperative for this cutting operation to be as swift as possible and this is indeed the case. The stacking mechanism which is directly linked with the guillotine and is operated as part of this cycle, receives the cut-to-size sheet and also the edge trimmings. The former is deposited on the pallet beneath and the latter tipped over the side as scrap. Notable feature of the take-off equipment is that it is mounted on rails and can be withdrawn easily for servicing and adjustment to the extruder die, screw or other parts which would otherwise be inaccessible.

Operations

The raw material, which in this case was Styron 475, manufactured by British Resin Products, Ltd., is fed to the extrusion hopper from ground-level bins (1) (3) by a compressed air operated pipe system. Two bins are used in the system, one containing new material and the other containing reground scrap made from the edge trimmings. The percentage of scrap material that is incorporated in the mix is governed by

a metering device (2). This device worked by a cam-operated switch controls the time that the feed pipe from the bin is in operation. Each of the feed pipes is fitted with this meter, thus providing a controlled rate of material input. This is necessary in order to maintain the efficient working of the powder drying and pre-heating plant (4). This plant blows heated air into the extruder hopper thus drying the raw material and effecting a certain amount of pre-heating. It is reported that not only does this improve the quality of the final product but also gives an increased output of up to 10%.

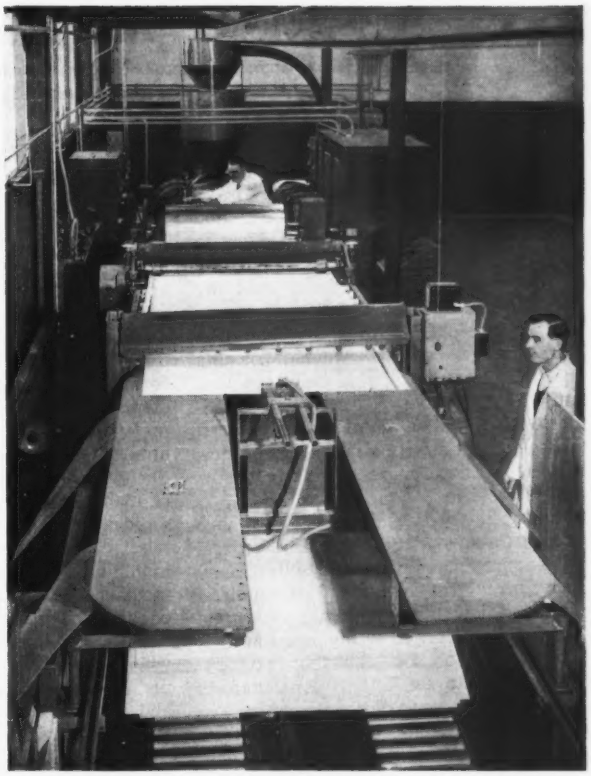
The extruded sheet from the die passes into the top nip of the polishing rolls (10) where it is laminated to a thin, transparent polystyrene foil (9) giving a polished surface of high gloss to one side of the sheet. The rolls are heated to temperatures of 175° to 200° F. but these temperatures are dependent on the speed of extrusion and amount of heat already in the extruded sheet as it leaves the die. The sheet is then fed through the other equipment which has been described in previous paragraphs.

Production

At the present moment all the production from this machine is scheduled ultimately for the refrigeration industry where, after vacuum forming it is to be used as door-liners and possibly in the future as interior liners. However, as the capacity of this equipment is estimated at between 600 and 800 tons of sheet per year it would appear that other markets will benefit.

There is, unfortunately, a limitation on the gauge of the sheet which can be produced. Minimum thickness is .020 in. and maximum .140 in. Although this provides a very adequate range for most applications especially where vacuum forming is visualized, this machine will not herald the era of the vacuum formed throw-away package as a material thickness of .005 in. would be necessary. Where a more substantial pack is wanted, however, the reduced cost of extruded sheet (estimated cost is between 5s. and 6s. per lb.) may now permit plastics to be competitive with the older materials. There are still untapped markets with the display, household and toy fields which will, no doubt, appreciate this new source of supply.

Physical properties of the sheet appear to be entirely satisfactory. The appearance, however, without laminating is matt but by laminating the polystyrene foil the gloss obtained is equal if not superior to that obtained by any other method of manufacture. At first the fact that only one side can thus be treated appears to be a disadvantage but on reflection the applications where it is essential for a double gloss finish to be used are few. Incidentally, the foil being used at the moment is still being imported from the U.S.A., but it is anticipated that manufacture in Britain will commence in a short while. Internal stresses set up in the sheet during manufacture are of a very low degree, less in fact than those set up by other methods. This point is of considerable importance where distorted printing prior to vacuum forming is in operation and results on line etched sheets show a repeating distortion pattern which will enable the printing to register after forming with consistent accuracy.

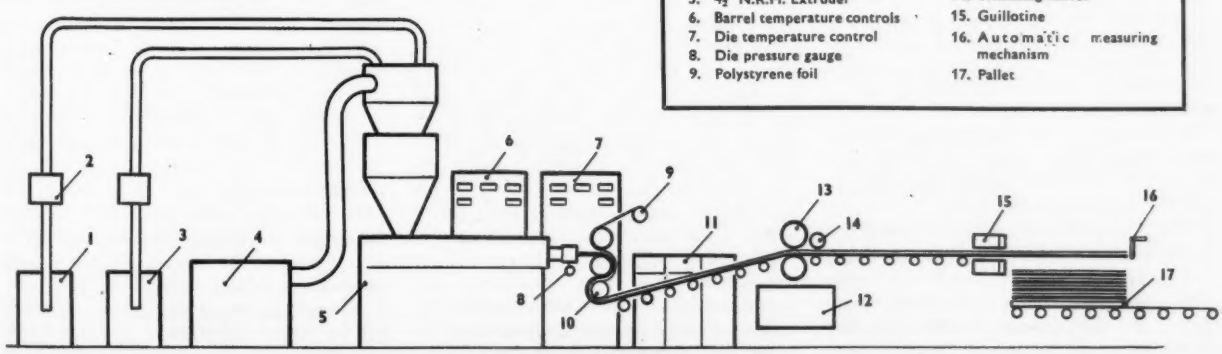


Edge trimming, guillotine and automatic stacking are shown in this photograph.

The production of Saroy sheet (the trade name which has been adopted) on this scale is the outcome of close co-operation between the raw material supplier, the equipment manufacturer, and Saro Laminated Wood Products, Ltd., who together have put on a production basis the first extruded toughened polystyrene sheet.

KEY TO DIAGRAM.

1. Raw material bin
2. Feed metering equipment
3. Raw material bin
4. Pre-heating and drying plant
5. 4½" N.R.M. Extruder
6. Barrel temperature controls
7. Die temperature control
8. Die pressure gauge
9. Polystyrene foil
10. Polishing roll
11. Roll temperature control
12. Take-off control panel
13. Draw rolls
14. Trimming knives
15. Guillotine
16. Automatic measuring mechanism
17. Pallet



Diagrammatic layout of the sheet extrusion plant.

LETTERS TO THE EDITOR

Correspondents are reminded that a stamped and addressed envelope should be enclosed in all cases where a personal answer is desired. It is understood that any letter received may be published at the discretion of the Editor.

Vacuum Forming and Injection Moulding

SIR,—It is apparent from the article in the February issue of *Plastics* (pp. 47-51), that direct competition is anticipated between these processes. In an effort to contribute towards a better understanding on this point I should like to add my personal findings. Early in 1953 my company developed for demonstration purposes, a simple vacuum-forming machine, and during this early period I must admit I envisaged certain competition with the injection-moulding process. These thoughts were natural as the new technique appeared so extremely simple and impressive.

Since those days, however, we have demonstrated and discussed this process with approximately 500 companies, many being prominent in the field of compression and injection moulding, and upon careful reflection it is my opinion that the competition between the two processes is quite small. It is, therefore, wrong to attempt to directly compare two separate techniques which both in their own right, have very positive advantages for their particular applications.

The term vacuum forming has become recognized as an individual technique, as have injection and compression moulding, although basically the process is a development of the earlier method of manipulating thermoplastic sheet, and as such has not increased appreciably any competition which may previously have existed.

Consider first the fact that a very high percentage of work eminently suitable for vacuum forming is impracticable by the injection-moulding process, such as large mouldings in the thinner gauge of materials, blister packs, box liners, show cards, display plaques, etc., where the material gauge used is from 5/1000-in. to 30/1000 in. in these cases, the area and thickness make them unsuitable for injection moulding, unless the moulder is prepared to accept the complications of mould heating and special multi-gating. Personally, I feel this type of work is the true value of vacuum forming, and being so eminently suitable is opening up an entirely new field.

It is only when the gauge of the moulded object becomes a feasible proposition for injection moulding, that price comparisons should be made.

There are always certain hypothetical items that one can imagine which could be equally well produced by both methods, but in reality this choice rarely arises, as the structural form is more suitable for one process or the other. The main consideration to take into account when choosing between the two processes is that vacuum forming is limited to shell-type mouldings, the sheet gauge thinning according to depth of draw. By the improved technique of drape forming however, gauge variations are more controllable.

With injection moulding varying structural cross sections can be incorporated.

A further consideration with vacuum forming is the inability to obtain sharp detail in the heavy gauges of some materials, which is due to the limited atmospheric force that can be applied by this process, normally between 25-28 in. of mercury on average equipment. This difficulty occurs with materials having relatively high resistance to flow at moulding temperatures such as methyl methacrylate, certain grades of p.v.c. and copolymers of vinyl chloride.

Better results are obtained by materials which are more yielding at these temperatures such as the cellulose acetate and high-impact styrenes, but in no instance can the detail be compared to that obtainable by injection moulding. Vacuum forming, due to the necessity to clamp an area of the material around the periphery of the blank and to allow spacing between impressions results in an inevitable scrap figure. This naturally varies with the size of vacuum box and shape of article. In many instances this represents 60% of the sheet blank and only in rare cases is less than 25%. As this figure appears quite startling I quote an actual instance. 1-in. half spheres at spacings of $\frac{3}{8}$ in. between impressions, requires a blank of 13 in. by 13 in. (169 sq. in.), for a total of 64 mouldings, these being subsequently blanked with a small flange. The total area of material used is 64 sq. in. thus showing a 62% scrap figure which has only a very nominal recovery value. On the other hand in injection moulding, gates and sprues are returned to the machine and practically no wastage occurs. Add to this the fact that in case of cellulose acetate the granules are approximately half the cost of processed sheet, also the extra labour generally involved in cutting the vacuum-formed pieces from the sheet, as opposed to degating of moulded parts, and it will be seen, provided the quantity justifies the tool cost, and the subject is suitable for injection moulding, there is little doubt which is the more economic process.

From the foregoing remarks it will be appreciated that both processes have qualities which justify individual recognition. Finally one word concerning the larger type of mouldings, i.e., refrigerator liners, door panels, caravan sinks, television masks, nursery baths, etc. Here, I feel the balance is in favour of vacuum forming, as the high tool cost, and the necessity to use the larger injection-moulding machines are not justified by the quantities involved, especially in the English market, where designs are changed frequently. Further by a single large moulding which avoids the spacing necessary for multiple moulds, the scrap percentage is greatly reduced. The mould required being only single, either male or female, cast in aluminium with provision for water cooling, the cost represents a small amount by comparison with the complicated machined type necessary for injection moulding.

Reference was made in the article to the advantage of the lower capital outlay involved in the vacuum-forming equipment as opposed to the injection-moulding machines.

In principle, of course, I agree, but I feel certain that it is not appreciated how many different types of machines of British manufacture are becoming available. In much the same manner as the first injection-moulding machines progressed from inexpensive hand-operated units to full automaton and increased in size and price, so is the trend in vacuum-forming equipment.

As a matter of interest I briefly outline the types and approximate prices of machines now becoming available:—

1. Simple basic machine, hand operated, moulding area 23 in. by 25 in., approx. cost £400.

2. Fully automatic, size as previous machine, requiring material loading and unloading. By push-button the heater moves to position for a pre-set period, the vacuum being applied as the heater returns to neutral position. Cost approx. £725.

3. Fully automatic machine, moulding area 28 in. by 28 in., intended for production of blister packs from continuous reel stock. Fitted with roll feed cabinet. take-off table and hand guillotine for shearing the material as it progresses through the machine. Pressure regulator fitted to air supply, complete with automatic blow off. Cost approx. £1,000.

4. Fully automatic machine with draping attachment, maximum drape 7 in., moulding area 23 in. by 25 in., automatic blow off, adjustable speed and pressure for drape attachment. Approx. cost £975.

5. Fully automatic drape-forming machine, moulding area 38 in. by 38 in., maximum drape 15 in., power rise and fall for heater adjustments, variable speed and pressure for drape attachment, built-in

(Continued at foot of next page)

British High-density Polythene

I.C.I'S PLASTICS DIVISION LAUNCH NEW MATERIAL, ALKATHENE H.D.

READERS may remember that in May, 1955, we rushed to Germany to listen to the first news of a new polythene of extremely high molecular weight, which was also stiffer than the variety made in this country and also more resistant to heat. The introduction of this new German discovery and almost simultaneously of the Phillips process in the United States was regarded as of major importance since for the first time a truly thermoplastic material could be used at temperatures above 100° C.

Readers will remember also that the process of production was entirely different from the English method, entailing the use of special metal complexes as catalysts.

The advantages in extending the use of polythene to cover new applications were obvious and there was quite some despondency in Britain that the new materials would apparently only be available from Germany and the United States.

The announcement on March 2, this year, by the Plastics Division of I.C.I. Ltd., that a new high-density polythene was to be made in Britain was of the greatest importance and interest to British industry.

It will be recalled that both the German and American processes are of the low-pressure type; the high-density I.C.I. material, soon to be available in development quantities, is manufactured by a traditionally high-pressure process used by I.C.I. since the company first commenced the manufacture of polythene before the war.

Whilst the use of catalysts makes possible the use of lower pressure, there remains the problem of metallic contamination; the removal of this contamination may well offset, from the price standpoint, the reputed saving by operating with low pressure conditions. At the moment, the price of I.C.I. high-density material is to be 4s. per pound, roughly 1s. per pound more than standard grades. This should, therefore, offer very close competition to German and American markets.

The properties of "Alkathene" HD suggest that it will be particularly suitable for mouldings. Advantages for this and other applications are:

Mouldings. Can be sterilized at temperatures of 110° C. without distortion.
Possible raw material saving through reduction in wall thickness.
Improved stiffness and finish.

Pipe. Higher working pressures and greater heat resistance.

Cable. Thinner insulation and tougher sheath—higher service temperatures.

Film. Less permeable to water vapour and gases; more resistant to oils and fats.
At present, however, "Alkathene" HD films have a tendency to be shock-brittle.

Typical properties of "Alkathene" HD are compared with those of standard "Alkathene" 20 in the following table:

Table I.

Property	"Alkathene" HD	"Alkathene" 20
Melt flow index (grade number)	0.7	20
Density	0.940 grams/c.c.	0.92 grams/c.c.
Ultimate tensile strength straining rate:		
6"/min.	2,580 p.s.i.	1,600 p.s.i.
12"/min.	2,750 p.s.i.	1,580 p.s.i.
18"/min.	2,900 p.s.i.	1,500 p.s.i.
30"/min.	3,200 p.s.i.	1,400 p.s.i.
Elongation at bread:		
6"/min.	380%	450%
12"/min.	300%	490%
18"/min.	200%	490%
30"/min.	180%	500%
Vicat softening point ..	116°C.	83°C.
Stiffness modulus at 20°C. ..	5×10^4 p.s.i.	2.6×10^4 p.s.i.
Environment stress cracking test (I.C.I. test using "Lissapol" N)	1.75 hours	0.25 hours
Low temperature brittle point	below —70°C.	—30°C.
Colour possibilities	Excellent natural colour. Readily pigmented to any shade.	Excellent natural colour. Readily pigmented to any shade.
Electrical properties	Excellent. Equivalent to standard "Alkathene."	
Moulding and extrusion ..	Can be handled on most standard equipment to give products with good surface finish.	
Permeability	Less permeable than "Alkathene" 20 to most vapours and gases—e.g., for hydrogen the figures are Alk. HD.—0.2×10^{9} Alk. 20 — 0.9×10^{9} ccs./cm./cm.^{2}/cm.Hg./sec.	

LETTERS TO THE EDITOR

(Continued from previous page)

compressor for air supply, automatic ejection of component from mould by compressed air. This machine has infinite variable controls and adjustments on all sequences of operations. Price approx. £2,250.

6. Similar machine, but with moulding area 70 in. by 38 in. Approx. cost £3,250.

Lastly, a Continental fully automatic, double-ended drape forming machine, each end having a moulding area of 60 in. by 40 in. Minimum depth of drape 22 in. This machine automatically clamps and locks the material blank in position. All moulding sequences are infinitely variable and controlled. Price approx. £5,300, including import duty.

Naturally I realise that the views expressed in your article are tentative, and that as the whole process of vacuum forming is still comparatively new, there must be many other opinions on this matter. No doubt other correspondents will be inspired to advise you of their experiences, and it is surely from the sum of these that the final judgment will result.

L. J. MONCRIEFF.
Plastics Development Laboratory.
British Celanese, Ltd.,
Hanover Square,
London, W.1.

Vacuum Forming and Injection Moulding-machine Costs

SIR,—I was very interested to read part I of your article on vacuum forming and injection moulding.

I feel, however, that the comparisons drawn assume that the manufacturers concerned are in possession of the capital equipment required. If the price of large injection machines and vacuum forming machines were included in the estimates, I feel that a very different picture would result.

M. G. BURGES-SHORT
T. H. and J. Daniels, Ltd.,
Lightpill Iron Works,
Stroud, Glos.

Cold Beer for Equatorial Africa

Reinforced plastics used to make a prefabricated storage unit for service under tropical conditions. Details of a new French development.

Fig. 1. (Left) A typical panel unit, easily carried by a girl.

Throughout the world the fabricators of glass fibre reinforced plastics have, on the whole, followed a common road, indeed often treading in exactly the same steps as those who had gone before: aircraft construction (radomes, air-ducts, spinners, leading edges, wing-sections and rudders), and in the industrial field, boats, helmets, tanks, piping, motor-vehicle and caravan roofs and walls, small car and motorcycle bodies and so on. The sequence has been common to almost all countries in type and time.

It has been left to France to introduce an application in an entirely new field which bears the imprint of at least as much promise as any of the foregoing and of intelligent and careful thinking and calculations. Its success may well prove a god-send to tropical countries and of not much less importance in many temporate climates. We are indebted to the Editor in Chief of "Industrie des Plastiques Modernes" for permission to publish the following notes from the January issue of that journal.

THE problem of the preservation in storage of foodstuffs and similar materials liable to very rapid spoilage and actual decomposition by bacteria and viruses has occupied human thought for thousands of years, but never has the technology of the subject been closer to solution (if we exclude the use of preservatives and the possibilities of radiation) as it is today, with the advent of the new types of plastic structures: their low coefficient of heat conductivity make for low temperature maintenance at lower costs, while low density, high strength and new constructional methods incorporating intelligent design make for low-cost transport and a rapidity of construction hitherto inconceivable with traditional materials.

Nowhere do the advantages and needs appear so great and urgent as in tropical countries, so that it is interesting to describe the result of the demand by a large brewery in French Equatorial Africa at Bangui—the Brasseries MOCAF—for a large cold chamber entirely constructed of plastics. Because of the more obvious technical and economic considerations involved, and because of the lack of skilled labour at Bangui, it was necessary to conceive a very easily mountable structure. The construction companies, the Union Africaine des Cuirs et Plastiques and the S.O.P.A.M.E., collaborated and decided on a form (see Fig. 2) based on relatively small prefabricated panel-like units which could be readily interlocked and simply bolted and screwed together. One of these units is shown in Fig. 1. All are nearly 12.8 centimetres thick and most of them 2.5 metres by 1.2 metres high. Others are slightly smaller in width to fit the size of chamber required.

Construction of the Panels

Each panel is virtually a box or enclosed sandwich made up of an outer skin of glass fibre/polyester resin within which is contained a foam of rigid polyvinyl chloride (made by Etablissement Kleber-Colombes). As will be seen from Fig. 3, an additional reinforcement to the walls is provided

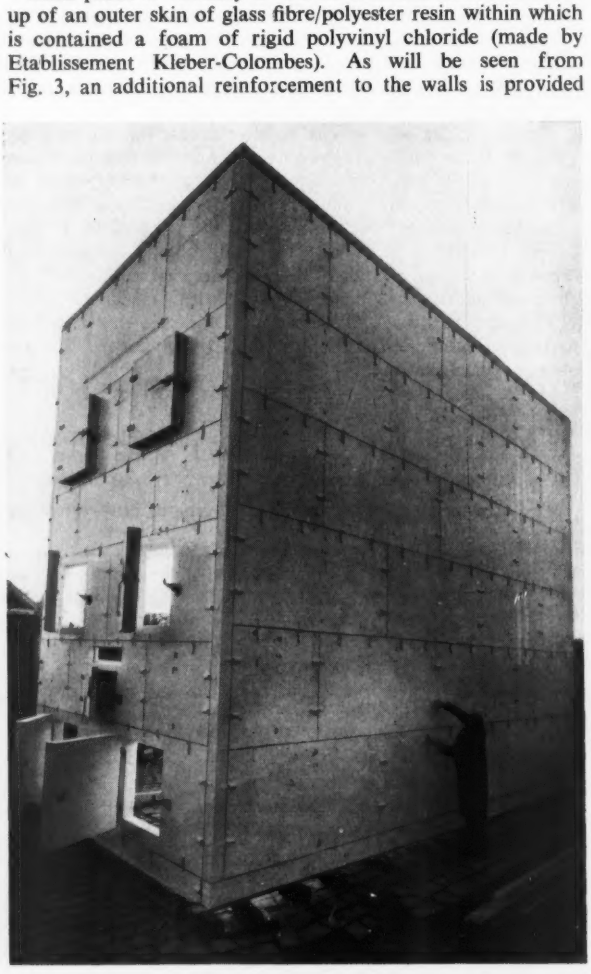


Fig. 2. A storage plant for beer in French Africa.

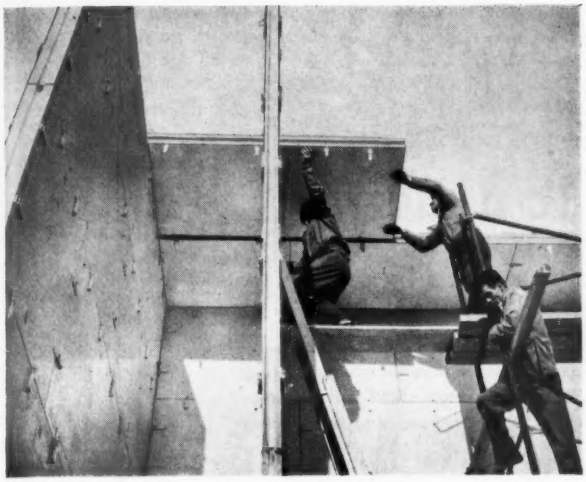


Fig. 3. (Left) Panels for the roof section being placed in position.

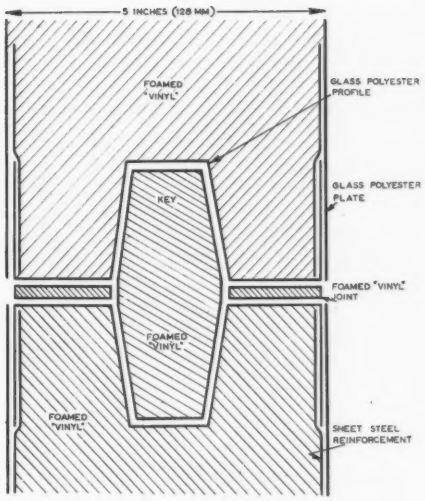


Fig. 4. (Right) A diagrammatic sketch which shows the "key" section, forming the joint between panels.

by thin sheets of steel cemented to the inside faces of the glass fibre/resin sheets. These steel sheets and the simple clamping toggles and screws necessary to hold the units together are the only metal components in the whole structure.

The manner of assembly of "panel upon panel" is ingenious. It will be seen from the drawing that the upper and lower edges of the units incorporate longitudinal three-sided channels, so that when two units are placed together there is formed a "continuous" hexagonal channel. In this space is fitted a number of hexagonal "keys" or tubes, made also of glass fibre/polyester resin filled with soft foamed polyvinyl chloride. To ensure an airtight joint between the sections and the prevention of heat conduction to the "key," and so to the other face of the wall, the interstices are also filled with a soft foamed p.v.c. jointing suitably cemented to the structure. Obviously, an additional function of the longitudinal "key" structure is to increase the rigidity of the entire chamber.

At each corner of the structure rigidity is maintained by 6.60-metre (21⅝-ft.) high angle posts; the whole rests on base "girders" (see Fig. 5) while the roof is similarly braced All these units are also of the same reinforced plastic.

The overall size of the structure is 6.8 metres high, while the base is 4.4 metres by 8.3 metres, the total cubic capacity being 230 cu. metres.

Within, the chamber is further divided into two by walls made of the prefabricated unit. One chamber contains six beer tanks, the other containing the pumping system and temperature-recording instruments.

In all, the chamber weighs slightly more than 2,200 kg. (4,840 lb.), which includes 1,800 kg. (3,960 lb.) reinforced plastics, 21 cu. metres of foamed p.v.c. and only 200 kg. (440 lb.) of metal sheet, metal clamps, bolts and screws, etc. The whole was erected in three days.

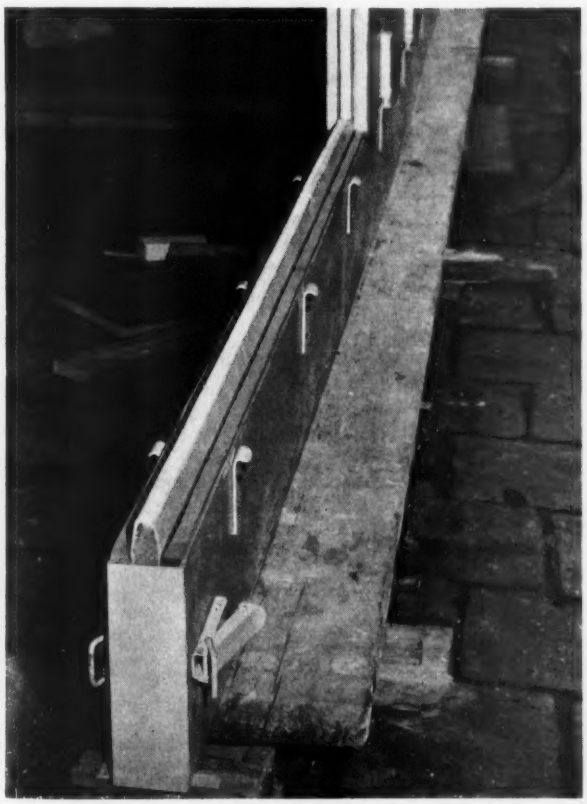


Fig. 5. The base strip, with the key section in position.

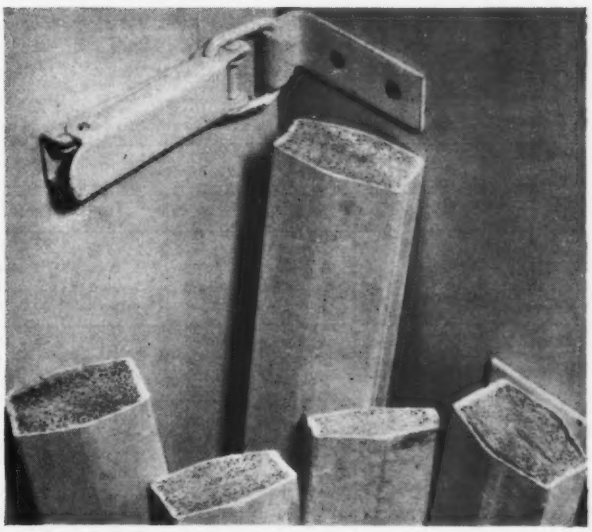


Fig. 6. Close-up to show profiles of keys, and strap clips.

Vacuum Forming and Injection Moulding

PART II. Future trends and their effects on price.

Following our survey of the current economics of the two processes published in February we have, in this the second and final part, attempted to forecast the developments which will probably occur in the vacuum forming industry. The economic changes which such developments will bring present a new set of problems some of which we have propounded here.

IN the February issue of *Plastics* we published the conclusions reached on the economic advantages, or otherwise, of the vacuum forming technique. These conclusions based on the existing circumstances in this country brought to light a state of affairs which should not be viewed with complacency. It is therefore proposed in this article to examine the development which must take place to establish vacuum forming as a recognized moulding technique.

Since development in the U.S. has gone ahead so much more rapidly than elsewhere, we can turn to experiences there (but bearing in mind the greater field, and differences in population characteristics) for an indication of the pattern development will take here. An outstanding feature of the American scene and a feature which is the only logical advance that can be taken here, is the use of extruded sheet material. It was apparent from the figures appearing in February that material costs are of primary importance and a reduction in these must be the first step in establishing vacuum forming. The extrusion of sheet is the most obvious way of doing this and a number of suitable extruders are now on the market although they appear to be mainly of foreign design. A logical step is the linking of the extruder directly to the forming machine, thus benefiting from the heat used in the making of the sheet for forming it.

The creation of a continuous process, however, appears to bristle with difficulties since it would seem obvious that the speed of forming, which can be easily varied, must conform to the speed of extrusion, which cannot. Obviously too, in ideal conditions, the temperature of the moving extruded sheet (which can vary considerably between morning and afternoon in a badly designed factory) must be "lined up" with the heating system of the vacuum former.

At the S.P.I. conference last year, John J. Buchner gave the following warning. "The extrusion of a quality sheet is no cut and dried procedure. Even with the best controls, materials of the same type vary from one batch to the next, and extruder speeds and temperatures must be varied accordingly in order to maintain quality. The optimum extruder speed is by no means a fixed quantity. The same thing holds true for the optimum speed for forming. Thus these two dissimilar operations can be performed to best advantage and at lowest cost only when they are performed independently of each other. And there seems to be no reason to expect that this will not continue to hold true in the future.

"Yet improvements in extrusion techniques are being made constantly. I feel safe in saying that new methods and mechanical equipment now actively under development may soon obsolete many of our present methods—and quite possibly much of our present extrusion equipment."

First of all let us examine the reduction in material costs that extruded sheet will incur and in consequence the effect that these will have on the "cross over" points established from the figures published in February.

Other factors will be influenced by the extrusion method as well as the actual material costs. These include running costs, depreciation, return on capital outlay and finishing costs but the sum total of these variations would be relatively insignificant and can, therefore, be ignored in establishing the "cross over" points.

The estimated cost of acetate sheet made by the extrusion process should be considerably less (say 4s. 4d. lb.) than the present price of pressed sheet. This figure is based on the American market where extruded sheet is between 10 and 20 cents per pound dearer than moulding powder. The price of cellulose acetate powder is around 50 cents per lb.

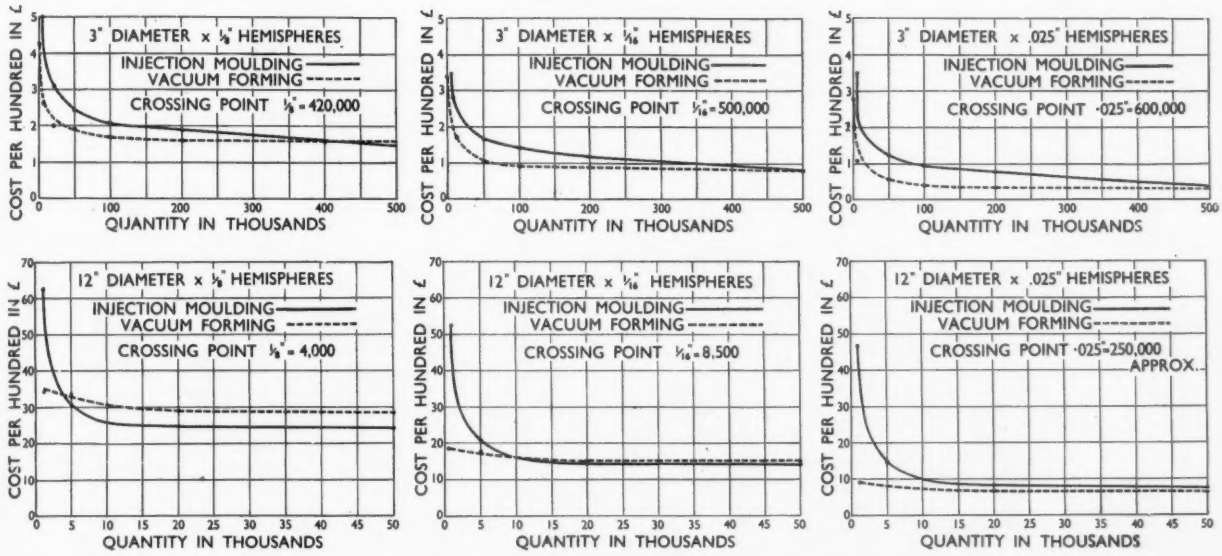
Vacuum forming costs for acetate hemispheres with material at 4/4 lb.

	QUANTITY					
	1,000	5,000	20,000	50,000	100,000	200,000
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
2"×.025"	2 15 10	12 10	8 5	4 5	4 1	2 9
2"×1/16"	2 16 8	13 8	9 3	5 3	4 11	3 7
2"×¼"	2 18 4	15 4	10 11	6 11	6 7	5 3
2"×.025"	3 1 5	1 0 3	10 11	7 3	5 8	4 6
2"×1/16"	3 6 11	1 5 9	16 3	12 7	11 0	9 10
2"×¼"	3 15 2	1 14 0	1 4 3	1 0 7	19 0	17 10
3"×.025"	2 16 4	1 2 4	14 1	10 9	8 8	7 1
3"×1/16"	3 7 6	1 14 0	1 4 9	1 1 5	18 8	17 1
3"×¼"	4 5 6	2 11 6	2 0 9	1 17 5	1 13 8	1 12 1
12"×.025"	8 19 0	8 7 0	6 14 6	6 11 5	6 6 0	6 5 0
12"×1/16"	18 11 0	17 19 0	14 19 6	14 16 5	14 11 0	14 10 0
12"×¼"	34 11 0	33 19 0	28 14 6	28 11 5	28 6 0	28 5 0

Table of estimated costs for vacuum forming with extruded sheet material.

A comparison of the tables with those of last month shows that vacuum forming is now a really serious competitor for the mouldings taken as examples here. The difference between the two costs in the higher quantities is, as can be seen, only very slight.

These figures are extremely conservative, particularly so on the output quantities where, in America, the figures of 300/400 lb. per hour material consumption and a 50-second cycle for forming are not uncommon. Nevertheless the cost margin appears to favour injection moulding for the greater


3" DIAMETER x 1/8" HEMISPHERES
INJECTION MOULDING
VACUUM FORMING
CROSSING POINT 1/8" = 420,000
3" DIAMETER x 1/16" HEMISPHERES
CROSSING POINT 1/16" = 500,000
3" DIAMETER x .025" HEMISPHERES
CROSSING POINT .025" = 600,000
12" DIAMETER x 1/8" HEMISPHERES
CROSSING POINT 1/8" = 4,000
12" DIAMETER x 1/16" HEMISPHERES
CROSSING POINT 1/16" = 8,500
12" DIAMETER x .025" HEMISPHERES
CROSSING POINT .025" = 250,000 APPROX.
COST PER HUNDRED IN £
QUANTITY IN THOUSANDS

It is very difficult to assess these points at the higher quantities owing to the close proximity of the two costs and limited variations that occur. It is also unwise to place too much reliance on such high figures as, no doubt, should such quantities be ordered the speed of moulding would be increased, the finishing operations made fully mechanical and in general a reduction of the listed costs effected. This, because of the relatively small difference, will make vacuum forming as cheap, if not cheaper, than injection moulding.

From the graphs and tables the following conclusions can now be drawn.

(1) The small mouldings are cheaper when vacuum formed no matter what quantity is visualized.

(2) Even on large quantities of heavy objects the difference in cost is only slight.

This last point brings to mind the case of the refrigerator door liner, which is held up as a most profitable venture for vacuum forming. Estimated costings have been prepared based on liners which weigh 4 lb. and 2 lb. Quantities of 5,000, 50,000 and 500,000 have been estimated.

The vacuum forming costing has used a material cost based on the consumption of 4½ lb. and 2¼ lb. of sheet per liner. The running costs are based on the use of two operators with an output of 50 liners per hour.

quantities, assuming that they would be produced in a single run and not in small batches.

Having seen the financial gain made by the use of extruded sheet, consideration should be given to the other factors which are connected with this process. First of all the original advantage of low capital outlay on a vacuum forming machine has now been negated to some extent. The cost of an extruder and die for sheet extrusion is between £3,000 and £6,000 and on top of this there is the take-off equipment to be taken into

Refrigerator door liner vacuum formed

	4 lb. wt.			2 lb. wt.		
Quantity	5,000	50,000	500,000	5,000	50,000	500,000
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Material	80 0 0	80 0 0	80 0 0	40 0 0	40 0 0	40 0 0
Tool	1 0 0	3 5	10	1 0 0	3 5	10
Running	2 0 0	2 0 0	2 0 0	2 0 0	2 0 0	2 0 0
Finishing	3 10 0	2 0 0	1 10 0	3 10 0	2 0 0	1 10 0
Extras	10 0	8 0	2 0	10 0	8 0	2 0
Total	87 0 0	84 11 5	83 12 10	47 0 0	44 11 5	43 12 10
Tool cost	50 0 0	85 0 0	200 0 0	50 0 0	85 0 0	200 0 0

Material cost estimated at 4½ lb. per liner and 2¼ lb. per liner. Running: 2 operators. Output 50 liners per hr. (official qty. 300/400 lb./hr.).

Refrigerator door liner injection moulded

	4 lb. wt.			2 lb. wt.		
Quantity	5,000	50,000	500,000	5,000	50,000	500,000
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Material	60 0 0	60 0 0	60 0 0	30 0 0	30 0 0	30 0 0
Tool	40 0 0	4 0 0	8 0	40 0 0	4 0 0	8 0
Running	10 0 0	10 0 0	10 0 0	10 0 0	10 0 0	10 0 0
Total	110 0 0	74 0 0	70 8 0	80 0 0	44 0 0	40 8 0

Running: 3 min. cycle. Tool cost: £2,000.

A comparison of estimated costings per 100 for refrigerator door liners based on a sheet material cost of 4s. 4d. lb. and moulding powder cost of 3s. 0d. lb.

account but even so this will still compare favourably with the cost of an injection-moulding machine of such capacity as to be able to mould these large objects.

Secondly, the finish obtained on the extruded sheet may not be as good as that obtained by other methods, and in consequence the appearance of vacuum-formed objects suffer in comparison. Research on this problem is meeting with some success and a glazed surface finish on extruded polystyrene sheet has been available in the U.S.A. for some time either by calendering or laminating and is now available in this country (see page 74).

There is one other factor which has not, so far as we are aware, appeared to any extent in this country but has, in America, become a common development, and should, therefore, be considered here. This is the installation, by what would be the industry's biggest customers, of plant for vacuum forming their own articles. The customer who, for example, estimates using half a million packs per month, will clearly consider investing in a vacuum forming machine and extruder or even two such set-ups. This, although appearing to be detrimental to the custom former, is not as bad as it seems in that such large quantities would tie down a lot of equipment on one order and may make the moulder too dependent on one customer.

Markets

Much has already been said and written on the possible markets for vacuum-formed articles and we do not, therefore, propose to go into this subject too thoroughly. The general concensus of opinion seems to rightly point to the packaging field as the largest potential customer. Among the other fields are advertising, both outdoor and indoor, domestic ware, and refrigerator parts.

None of these compares with the enormous potential of packaging. The vast quantities required can easily be handled on multi-cavity moulds; thin-wall sections and contour packages are both a practical and even advantageous proposition; short delivery dates and quick production of prototypes for market estimation are easily accomplished; and add to these the inherent advantages of the material and low cost per package and all that remains to be done is to sell the idea.

It is worth noting that the introduction of the Kabertit process from Germany has caused considerable interest in this country, principally from manufacturers of consumer goods. This process although not a vacuum forming process does utilize the heat from the extruded sheet for forming the container and it is a continuous process. If there is such interest it would seem that the idea is already half sold and we can expect developments on these lines in the not too far distant future. Already companies offering both "skin" and "bubble" packs are operating and examples of these and also of other legitimate applications were seen at the recent B.I.F.

Advertising plaques are dependent on a successful method of mechanical printing and full advantage being taken of the three-dimensional possibilities in the design. The design and printing of paper and cardboard units has reached such a high standard that to enter this market at the moment will be very difficult. Outside display signs seem to offer a more likely market although their size and consequent cost may prove a stumbling block.

Domestic ware appears to be at the moment exclusively injection moulded, but there is no reason why both processes should not be used although the greater proportion will remain, by its very design, injection moulded.

Refrigerator parts, principally trays and door liners, have provided a very profitable market in America although not so much for the custom former as for the machinery and raw-material manufacturer. It is reliably reported that one company alone used 2,000,000 lb. of material on this application. It is doubtful, however, if such a large market exists in this country because of the comparatively small quantity of refrigerators produced. In 1955 the total quantity of domestic refrigerators produced here was approximately 400,000. Assuming all these were fitted with a plastics door liner the order would only keep three vacuum forming machines in full production and would not take the full production from two sheet extruders. Visions of the extruder vacuum-forming line, mentioned in Part I as being in use in America, being adopted for this job over here are, therefore, rather optimistic. There is, however, a market and it is already being explored by several companies not only for the liner, but also for the forming of the trays. It is notable that the cost of forming liners using extruded sheet is such as to compare favourably with injection moulding so it may be that this market is destined for the vacuum formers.

Summary

To make a summary of the many and varied factors which govern the growth of vacuum forming is indeed a difficult job, depending as it does on the demand for its products. The extent of the interest by consumer goods manufacturers in the use of formed packages is largely an unknown quantity and will remain so until a package of low cost and attractive design can be offered with guaranteed delivery of large quantities (this factor incidentally points to the advisability of a self-contained unit); also it is important that de-staticizing, in particular of polystyrene, should be carried out.

These remarks apply equally well to the other markets considered although quantities may not be so large. These markets, it will be noted, with one exception, have not to any great extent been the injection moulders' prerogative and it can, therefore, be assumed that the development of vacuum forming will be in markets not available to injection moulding. The exception to this is the domestic-ware market and the greater versatility of injection moulding and the large machines now in use may make vacuum forming a "poor relation" to this process.

Developments in vacuum forming have been rapid even in an industry that itself is noted for quick expansion, but a warning which can well be repeated was given by Mr. V. L. Kienan, vice-president of the St. Regis Sales Corporation at the S.P.I. conference last year. Mr. Kienan said, "This tremendous potential can only be fully realized if we, the members of the S.P.I., assume in every respect our individual responsibilities. One of these responsibilities is to properly develop and sell new applications and markets. This can only be accomplished through the use of sound engineering principles, proper materials and quality of production based on a high degree of integrity.

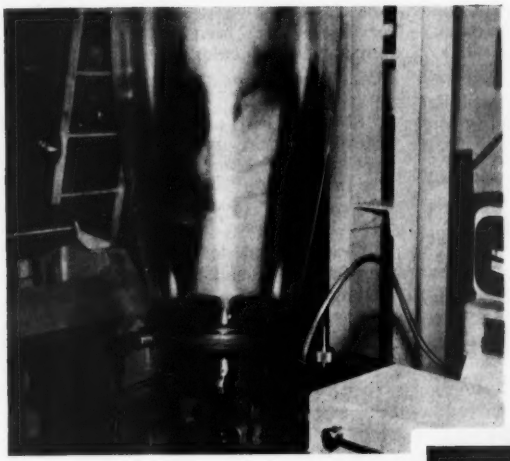
"The most significant responsibility is the protection of our industry. In our anxiety to bring about quick realization of this potential expansion, management must not overlook the sound principles of good business procedures and ethics. In order to safeguard the well-being and growth of the vacuum moulding industry we must look to the future and plan accordingly."

We have used the American pattern of development as a guide to what may happen here, but it would be unwise to regard it as anything more than a guide. Conditions, markets, equipment and many other factors prohibit a direct comparison (for example in the case of refrigerator door liners), but lessons can be learnt. Exactly what line progress will take over here is an interesting speculation and one which will only be proven by time.

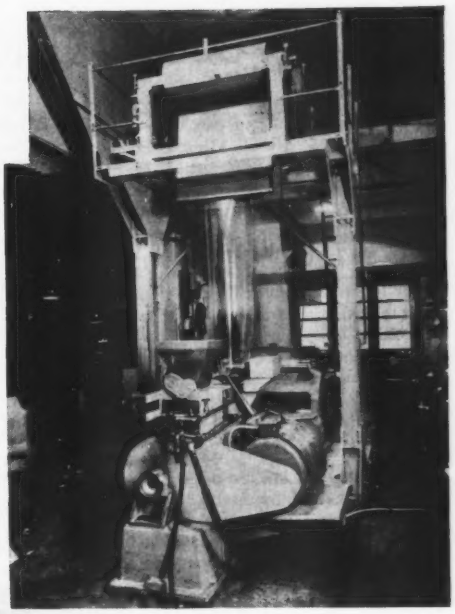
Finally, we should like to thank the many companies who have co-operated in the production of these two articles and also to thank the individuals whose advice and assistance has proved of the greatest value.

Layflat Tube Extrusion

PROVING TRIALS ON NEW MASON EQUIPMENT AT LUTON



(Left) Polythene bubble emerges from the die. A standard 2½-in. Mason extruder is used in conjunction with the plant.

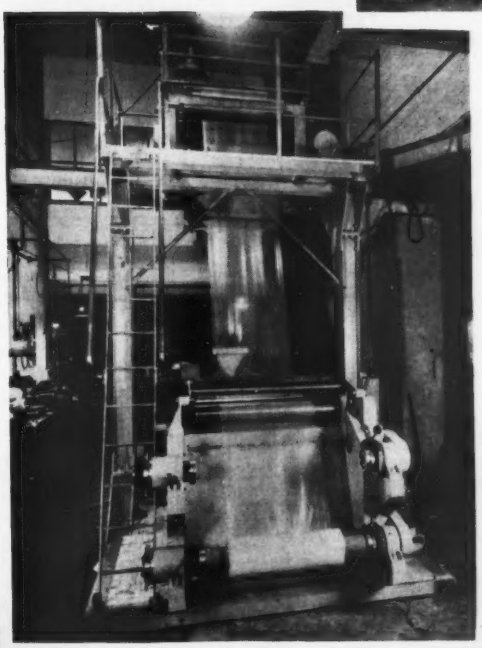


(Right) General view, extruder in foreground.

THE latest development to come from the works of N. Mason, at Luton, Beds, is a complete installation for the extrusion of layflat tubing in both polythene and p.v.c. The first plant was completed recently, and we spent a day at the factory whilst it was undergoing final test before shipment to the customer.

The performance of the installation was extremely satisfactory, notwithstanding the fact that unlike normal production practice, the extruder and bubble was not completely enclosed. Equally good results were obtained with polythene and p.v.c.

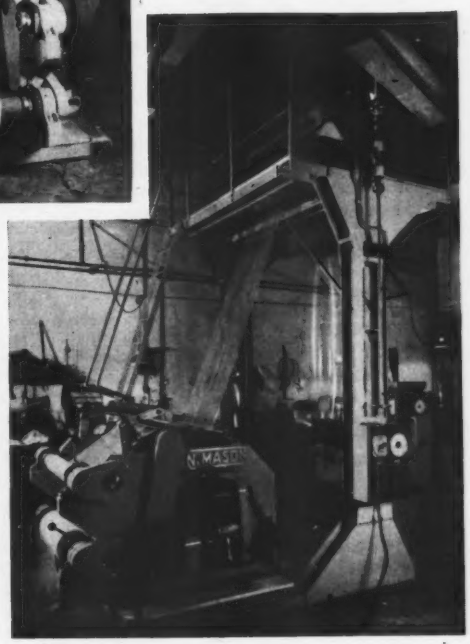
Based on the 2½-in. extruder, the plant is robustly constructed and extremely compact. The photographs on this page show the equipment from various angles, in operation. Although simple in design, the plant is the result of extensive research and development, and incorporates a number of new developments.



(Left) Reel-up end, showing flat tube coming from nip rollers on gantry down to slitters and reel-up rollers.

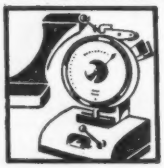
(Below) Side-view, control panel on gantry girder.

(Left) Bubble enters nip rollers on top of gantry. The flat tube can be seen moving down on the left of the photo.



World's Industry Employs Plastics

MATERIALS and TESTING



Electric creep path formation in plastics.—From investigations with a novel apparatus K. Schumacher draws the following conclusions: thermosetting and some thermoplastic materials show a stronger carbonization with increasing temperature. The amount of debris depends on the initial material, not the conductivity. This drops above 400° C. and has, at 800° C., the conductivity of ground graphite.
(*Kunststoffe*, 1956/Jan./14.)

High-speed tension testing.—J. Dorsey and coll. describe an apparatus which records stress-strain data during a tension test taking 5 to 15 milliseconds from start of loading to fracture. Permanent records of stress versus strain are made by oscilloscope cameras.
(*A.S.T.M. Bulletin*, 1956/Jan./34.)

Stress-strain diagram of polyamide.—W. Weidmann discusses the importance of the stress-strain diagram for the designer and which conclusions can be drawn to design safe components.
(*Kunststoffe*, 1956/Jan./16.)

Organic corrosion is a new name for the deterioration of rubbers, plastics, textiles and surface coatings in service. The economic value is probably equal to the corrosion of metals. Investigations at Bell Laboratories are described.
(*Bell Laboratories Record*, 1956/Jan./1.)

Unsaturated polyester resins.—B. Berndtsson and L. Turanen investigated the setting temperature and setting time of unsaturated polyester resins. The mechanical, dielectric and optical properties of one typical resin were investigated, considering in particular the low temperature setting.
(*Kunststoffe*, 1956/Jan./9.)

Fillers and reinforcements.—G. Lubin deals with types of fibres and powders and their functions. Influence of fillers on properties, surface finish, shrinkage. Effect of thixotrophy on moulding requirements and control of gel time.
(*Product Engineering*, 1955/Dec./178.)

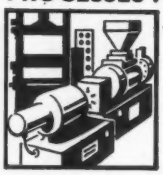
Investigation of p.v.c. plasticizers.—F. Wuerstlin and H. Klein investigated the behaviour of esters of monofunctional alcohols as plasticizers for p.v.c. Three basic characteristics were compared; plasticizing efficiency, solubilizing efficiency for p.v.c. and compatibility with p.v.c. The ester group is responsible to about 90% for solubility and compatibility in present-day plasticizers.
(*Kunststoffe*, 1956/Jan./3.)

Adhesive bonding of metals.—According to S. N. Muchnick, the strengths of adhesive-bonded metal joints can be made to approach the cohesive strength of the bonding agent if the metal surfaces are treated properly. With one organic adhesive, loads exceeding 7,000 lb./sq. in. have been required to break the adhesive bond between samples of stainless steel; 5,500 for aluminium; 7,000 for titanium, and 4,000 lb./sq. in. for magnesium.
(*Mechanical Engineering*, 1956/Jan./19.)

Cemented thin sheet-metal constructions.—E. W. Pleines gives a technical, well-illustrated survey on modern metal glueing techniques from both design and production angles.
(*Industrie-Anzeiger*, 1956/Feb. 17/10.)

Irradiated polythene.—Polymers can be classified in those that degrade through irradiation and those that can be cross-linked to form insoluble products with improved properties. After processing, a new type of polyethylene does not crack when stressed in the presence of active liquids, including household detergent solutions.
(*Machinery (Lond.)*, 1956/Feb. 24/29.)

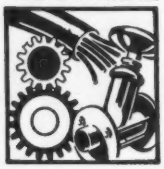
PROCESSES : MACHINERY



High-speed worm extruders.—E. Beck discusses the basic design factors of a new extruder. High peripheral speed, control and maintenance of stable extrusion conditions are points discussed.
(*Kunststoffe*, 1956/Jan./18.)

Plastics in the wire industry.—Survey of new plastics production machines seen at the Düsseldorf plastics fair.
(*Draht*, 1956/Jan./16.)

INDUSTRIAL APPLICATIONS



Glass-fibre reinforced synthetic resin rods have been tested as reinforcing element in prestressed concrete instead of steel. The rods have a tensile strength of 140 kg./sq. mm. and a fairly high chemical resistance. They may find applications where steel fails owing to corrosive conditions.
(*Kunststoffe*, 1956/Jan./37.)

Duplicate patterns with epoxy resins can be prepared successfully by semi-skilled labour and offer many advantages, typical designs are analysed.
(*Tool Engineer*, 1956/Jan./85.)

Protection to metal surfaces.—A fibre-reinforced cold setting plastics forms a corrosion-resisting coat for metal surfaces for nearly all forms of corrosion.
(*Design News*, 1955/Dec. 15/17.)

Polystyrene prototypes for investment casting.—Provide an inexpensive method for experimental purposes. The part to be produced is machined out of polystyrene, when complicated, several plastic pieces can be bonded together. The part is then used as a pattern.
(*Machine Design*, 1956/Jan. 26/60.)

Epoxy resin foundry patterns have a number of advantages for the casting and duplication of working patterns. Shrinkage during curing is very slight. Various methods have been developed for the production of moulds.
(*Machinery (Lond.)*, 1956/Feb. 17/267.)

Plastics-coated tank.—High-temperature chemically inert fluorocarbon plastics dispersions have been successfully applied to the interior of a 33-ft. highway trailer tank.
(*Design News*, 1955/Dec. 15/5.)

Graphite-filled sintered nylon lowers bearing friction.—Small bearing parts produced by cold pressing and oil sintering have low surface friction and dimensional stability.
(*Design News*, 1955/Dec. 15/7.)

MISCELLANEOUS USES

Helmet for supersonic baleouts.—A combination helmet and faceplate, enclosing the entire head, has a double-lens, air-spaced, full-face oxygen mask with pressure seal flap. Construction materials are laminated glass fabric polyester resin, cellular cellulose acetate, foam rubber and nylon cloth.
(*Aviation Week*, 1955/Dec. 12/33.)

Fittings for polyethylene pipe have been developed by an American firm. These are injection moulded from rigid unplasticized polyvinyl chloride and form a tight joint without setting up compressive stress in the polyethylene tube.
(*Products Finishing*, 1956/Jan./118.)

Plastics for truck bodies.—Summaries of five papers discussing the use of plastics for truck bodies, pick-up trucks, transport tanks and trailer bodies.
(*S.A.E. Journal*, 1955/Nov./39.)

Plastics in the laboratory.—The main types of plastics useful for the laboratory such as polyvinyl chloride, polyethylene and polystyrene are discussed.
(*Laboratory Practice*, 1956/Jan./29.)

Large plastics covers.—The U.S. Bureau of Ships has recently installed a plastics cover of sandwich-type construction with polyester shell and cellular acetate core on a propulsion reduction gear case.
(*Machine Design*, 1956/Jan. 12/145.)

Silastic heart valve.—Silicone rubber is a highly promising construction material for a substitute valve proposed by Dr. S. J. Sarnoff for use in the human heart.
(*Mechanical Engineering*, 1956/Jan./39.)

Sintered nylon bottom rests for file drawers wear only 0.001 in. after 30,000 drawer cycles, compared with 1/32 in. after 10,000 cycles for injection-moulded buttons.
(*Product Engineering*, 1955/Dec./153.)

Machines for the Industry

Extrusion Paper-Coating Plant

Coating paper with polythene, for packaging and many other applications, has developed greatly in the past two years. This article describes the Egan equipment, built in this country by Bone Brothers Ltd.; the extruder is of course used in many fields other than paper-coating.

FOR many years the products of the Frank W. Egan Co., in America have been well known to the rubber and plastics industries. Reliability coupled with high output figures have marked these machines down for special attention wherever large-scale processing of plastics materials has been carried out, and the British industry learned with considerable interest some three years ago that Bone Brothers Ltd., of Manor Farm Road, Alperton, Wembley, had undertaken to construct this equipment in Britain.

Bone Brothers have, for many years, specialized in the manufacture of equipment used by the paper industry and it was mainly their interest in the manufacture of machinery for coating paper with polythene that led to the tie-up between these two firms.

From the paper-coating plant to the manufacture of extruders for the general plastics industry was but a short step and they are now one of the leading manufacturers of extruders for the various types of plastics and complete plants are being supplied for the manufacture of layflat tubing, pipes, cable covering and flat film.

The extruders are supplied in sizes ranging from 1½ in. up to 8 in.—but this article deals with the 4½-in. extruder, which is the most popular size, and the extrusion laminating machine, and we were fortunate in securing the co-operation of Bone Brothers Ltd., in the preparation of this report.

4½-in. Extruder

The motor drive for the machine is usually by means of a 40 h.p. Ward-Leonard D.C. drive which comprises an A.C. motor driving a D.C. generator supplying current to the D.C. variable-speed motor driving the machine. A very wide speed range is obtainable and on the standard arrangement this range is 11 : 1 giving screw speeds of 8-88 r.p.m. The drive has a constant h.p. characteristic from top speed to half top speed, and below that it is constant torque. The less costly drive is by means of a 40 h.p. commutator motor, but this is limited in its speed range and is usually limited to 5 : 1 giving screw speeds of 16-80 r.p.m. Furthermore, it has a constant torque characteristic.

The drive from the motor to the extruder is by means of vee belts (1) to the gearbox in-driving shaft (2). This gearbox is fitted with double helical gears, splash lubricated, and has a ratio of 20 : 1. The gearbox is connected to the thrust bearing assembly by an all-steel flexible coupling (3).

The thrust bearing assembly (4) contains two double-row roller journal bearings and a spherical roller thrust bearing of adequate load-carrying capacity and which exceeds any load which can be exerted by the motor. The housing is of Meehanite and is pressure lubricated from Tecalemit rotary cyclic pump (5) and a pressure gauge is fitted in the line to indicate that the system is functioning. The bearing shaft, which is hollow, is bored and keywayed to take the screw at one end.

The feed box (6) is fabricated from steel, and is machined and jacketed for water cooling. It is fitted with a renewable liner through which the screw passes. Into the feed-box assembly is fitted the plastic hopper (7) which incorporates a visible feed and emptying chute and also a cut-off slide (8) to shut off plastic granule flow to the feed box.

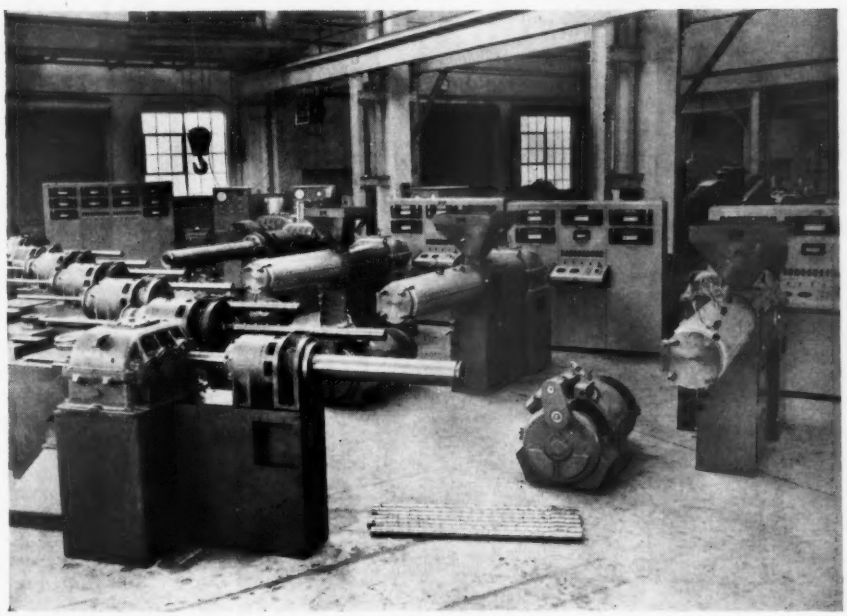
Extruder Barrel and Screw

The barrel (9), which is of carbon steel, is fitted with a hardened liner. Eight 6-kW. heater bands (10) are fitted around the barrel and are divided into four zones, each controlled by thermocouples (11) fitted into the barrel. The heating elements are enclosed within a removable sheet steel casing.

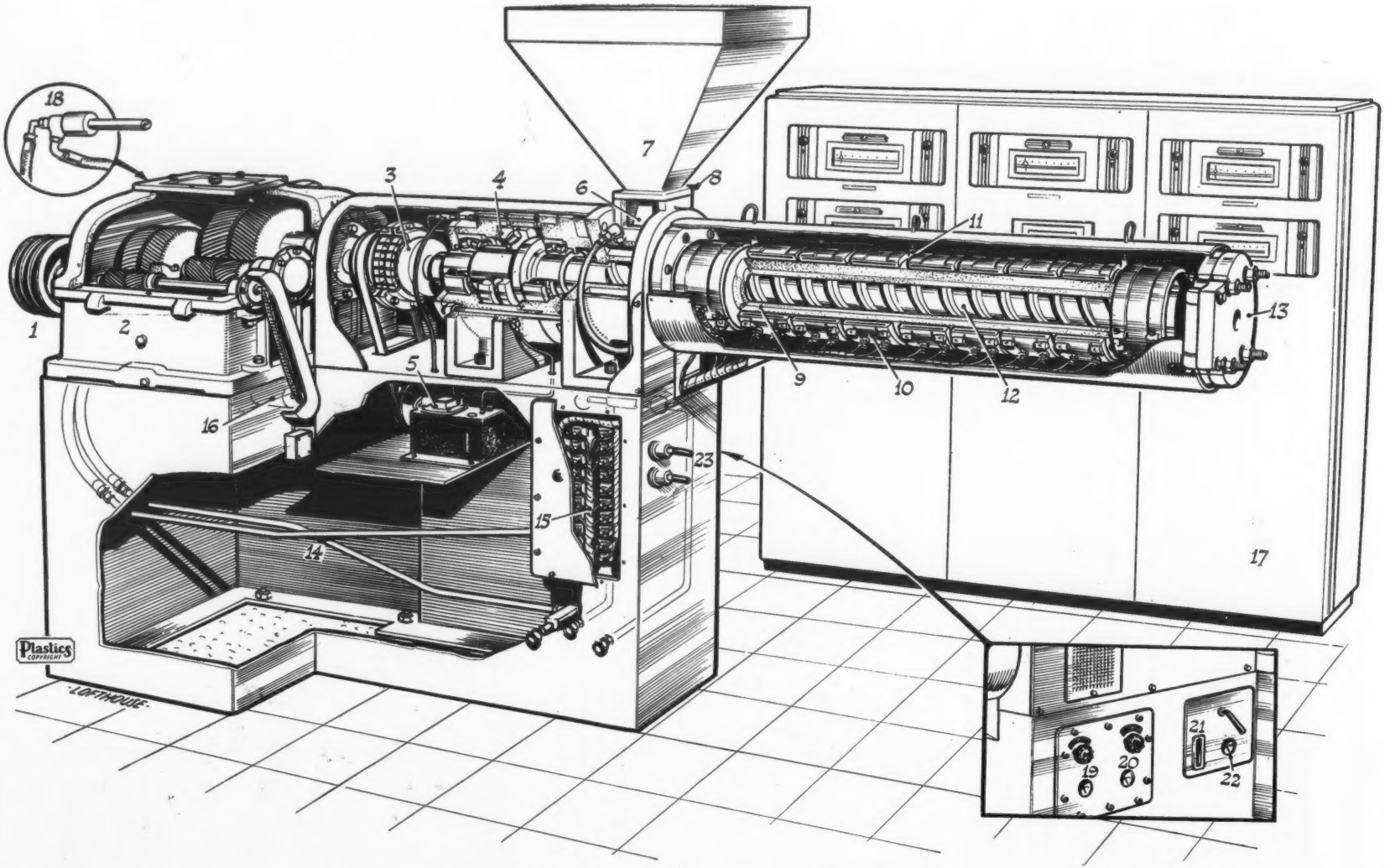
The screw (12), which is of special design, is of high tensile alloy steel, stellite tipped on the flights and ground and polished to a high finish. The screw is of the constant-pitch type terminating in a metering section and is water cooled through a rotary union fitted to a stem pipe into the end of the screw; the water returning and flowing to drain. The end of the barrel is fitted with a flange (13) to suit the die adapter.

The base is fabricated from heavy mild-steel plate, stress relieved and machined, and houses

(For machine drawings see following two pages. Text matter continued on page 88.)



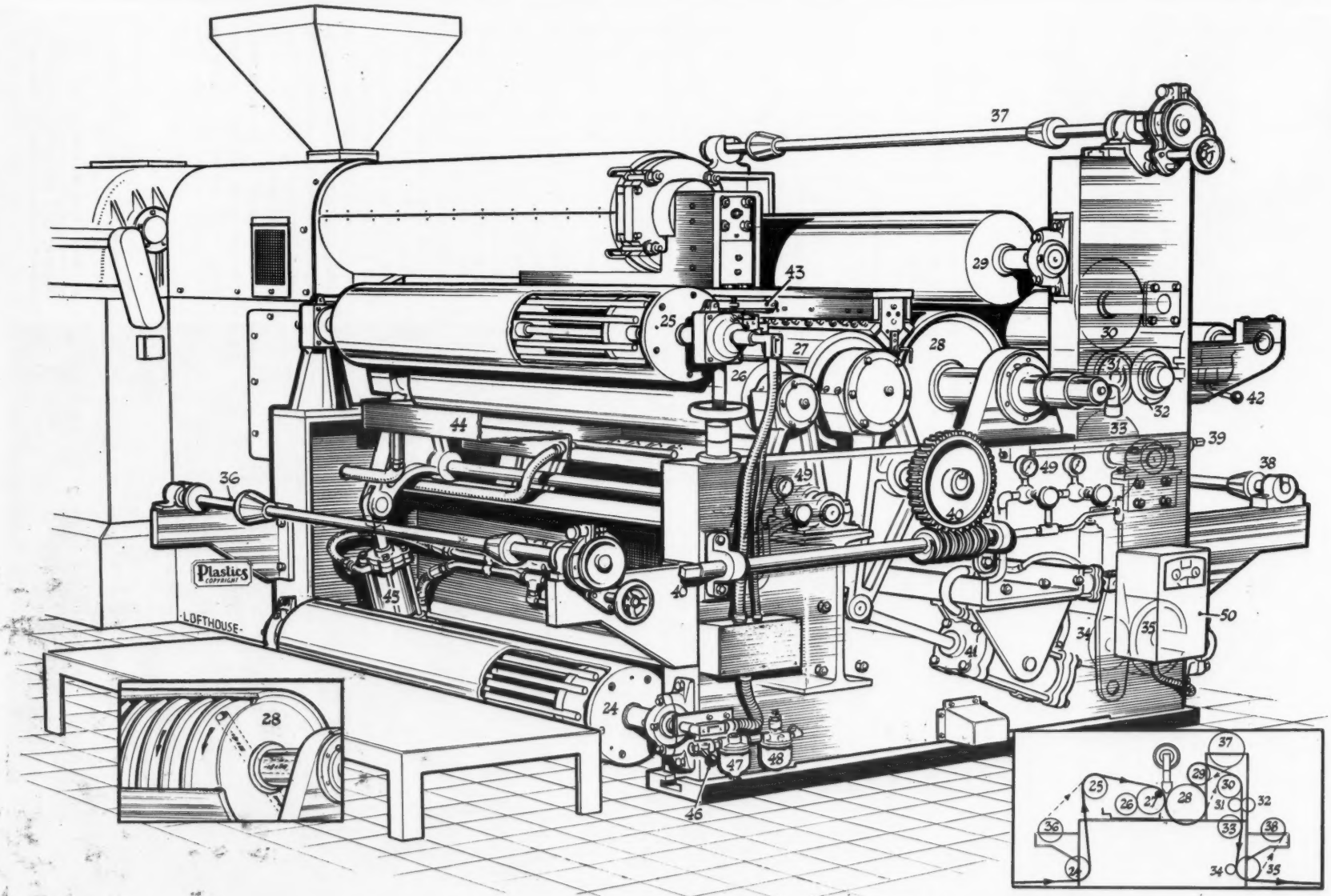
The main assembly shop at Bone Brothers Ltd., for the Egan extruders. A number of screws can be seen in the foreground.



THE EGAN EXTRUDER WITH CONTROL PANEL AT REAR.

(The parts of the machine are annotated with numbers related to the text. The machine drawn here is the 3½ in. unit, which differs only in slight detail from the 4½ in. unit described in the text.)

1.—Vee belt to gearbox in-driving shaft. 2.—Gearbox. 3.—Flexible coupling to thrust bearing assembly. 4.—Thrust bearing assembly. 5.—Rotary pump. 6.—Feed box. 7.—Hopper. 8.—Cut-off slide. 9.—Barrel. 10.—Heater bands. 11.—Thermocouples. 12.—Screw. 13.—Flange to suit die-adapter. 14.—Water cooling pipes. 15.—Terminal box. 16.—Tachometer generator. 17.—Control panel. 18.—Water cooling tube on a rotary union. 19.—Cooling water gauge for the tube. 20.—Ditto. 21.—Oil level on pump gauge. 22.—Oil pressure gauge. 23.—Connecting points for heater tanks on dies.



PAPER-COATING PLANT.—24.—Pre-heating rollers. 25.—Ditto. 26.—Chromium-plated doctor roller. 27.—Neoprene-coated pressure roller. 28.—Cooling cylinder. 29.—Lead roll. 30.—Straight pass roller. 31.—Slitters. 32.—Ditto. 33.—Straight pass roller. 34.—Pressure roller. 35.—Pull roller. 36.—Reel spindles. 37.—Ditto. 38.—Ditto. 39.—Adjustment for aligning laminating nip with extruder die. 40.—Vertical adjustment for pressure roller (27). 41.—Air cylinders. 42.—Disengaging levers. 43.—Automatic web break release. 44.—Water bath. 45.—Air cylinders. 46.—Air inlet control for pneumatic cylinders. 47.—Air cleaner. 48.—Air lubricator. 49.—Pressure gauges. 50.—Drayton temperature regulator.

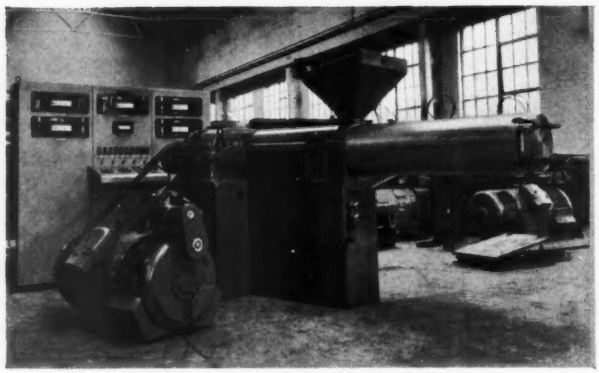
the lubricating pump, the water-cooling pipes (14) and the terminal box (15), to which are carried all the electrical connections to the heater bands. Removable doors are fitted for access to all services. The base also houses a tachometer generator (16) driven by chain from the gearbox input shaft.

The control panel (17) is fitted with 10 electronic proportioning type controllers which are capable of holding the temperature to an extremely fine degree. These controllers actuate contactors cutting off or applying current to the heater bands. The panel is also fitted with a pyrometer, which, together with a special thermocouple, gives a direct reading of the temperature of the plastic flowing through the adapter to the die.

This extruder is rated to deliver up to 350 lb. of polythene per hour.

Laminating Plant

This equipment is suitable for the application of polythene to one side of a web of paper, foil or film. Laminates of either of these materials may be made with a central layer of polythene. Reference should be made to the directional diagram shown at the bottom of the laminating plant drawing, from which it can be seen there are three possible runs of the material to be coated or laminated. First, paper from a simple unwind stand and around the pre-heating rollers (24) (25), above the chromium-plated doctor roll (26), which governs the thickness of the water film picked up in the water bath, to a neoprene-coated pressure roller (27), operated by air cylinders against a chromium-plated double-walled cooling cylinder (28). The polythene is extruded into the nip between the paper and the cooling cylinder and then passes to a lead roll (29), to a further roller (30), designed to give a straight pass between slitters (31) (32). From here the paper passes around a further roller (33) having the same function as (30) above, to a rubber-covered pressure roller (34) operated by air cylinders against a rubber-covered pull roller (35) driven through a friction clutch not shown. The remaining units (36) (37) (38) are reel spindles fitted with cones to suit standard strawboard centres carrying the paper, film or foil.



4½-in. extruder ready for shipment.

An alternative run is (36), (25), (27), (28), (29), (30), (33), (34), (35), (38). The third run is (36), (25), (27), (28), (30), (31), (32), (33), (34), (35), (38) with an additional web from (37) over (29) and between (27) and (28).

Film Laminator

This is constructed with heavy plate section side frames adequately braced and carried on soleplates. The laminating is carried out between a neoprene-covered roll (27) and a chromium-plated water-cooled drum (28).

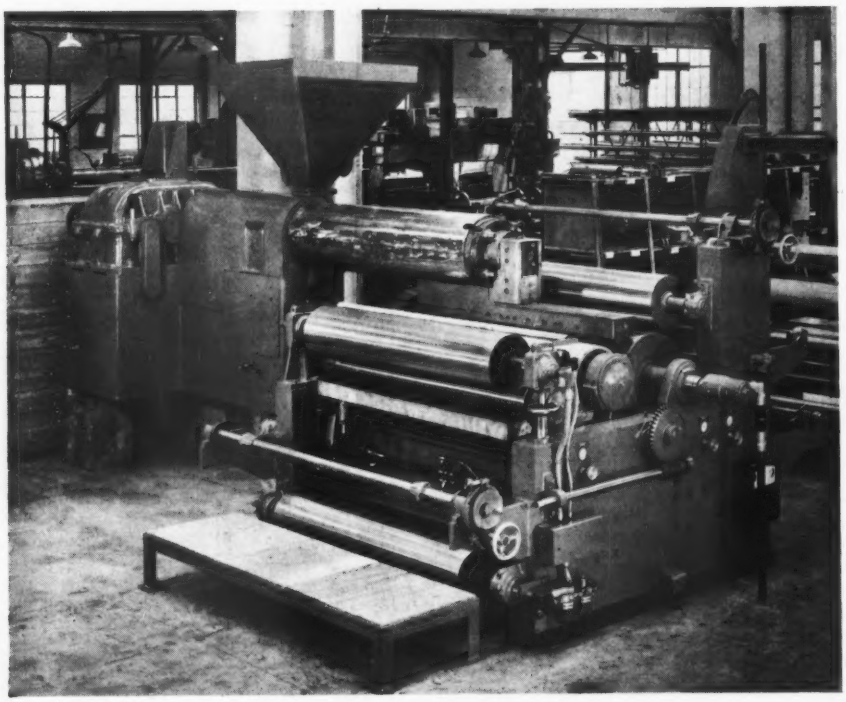
The cooling drum is a double shell welded roll, 18 in. diameter, and a special internal construction is used to ensure effective heat absorption at high coating speeds.

The outer surface of the cooling roll is ground, chromium plated and highly polished and is mounted in heavy roller bearings. An adjustment (39) is provided for moving the position of the bearings correctly to align the laminating nip with the extruder die, this adjustment being critical in obtaining proper adhesion.

The neoprene-covered roll (27) is 12½ in. diameter, and is mounted in roller bearings on heavy cast-iron pivoted arms. The arms are cross connected with a horizontal shaft mounted in plain bearings with a vertical adjustment (40). This adjustment permits maintaining a minimum distance from the die to the laminating nip.

The neoprene roll support arms are linked to air cylinders (41) and a laminating nip pressure infinitely variable up to 125 lb. per inch of face is obtainable with the usual air line pressure of 100 lb. per sq. in. Air pressure is controlled to all pneumatic cylinders by means of pressure regulators and push-button control valves, giving "in" and "out" positions.

The edge trimming attachment is mounted on the laminator, and comprises two pairs of shear-type



A view of a typical coating plant. In practice the extruder is normally mounted on a railway for easy withdrawal from the machine for cleaning.

ball-bearing slitters (31) (32). The inner set is mounted on a driven shaft, and the outer set is mounted on a supporting bar with adjustable clamps and individual disengaging levers (42).

Three 8-in. idler rolls (29) (30) (33) are mounted on the laminator frame in ball-bearing housings. The position of the leading-in roll is adjustable to correct for a slack edge.

Water is circulated through the cooling roll by means of a motor-driven centrifugal pump delivering 250 gallons per minute, and inlet and outlet to the roll is through 2-in. rotary joints fitted to the cooling roll journals.

Make up water requirements based on an 80° F. circulating temperature and 60° F. water supply temperature is approximately 30 gallons per minute, and this is automatically controlled by means of a bulb fitted in the flow line controlling a thermostatic control instrument operating the make up water feed valve.

An automatic web break release (43) is provided and operates a micro switch which can be made to stop the machine or the extruder.

A water bath is provided in which the neoprene roll (44) runs, doctored by means of a chromium-plated steel pressure roller (26), carried in totally enclosed roller-bearing housings on swing arms operated by air cylinders (45).

Double Drum Winder

The double drum winder which is for use with mill reels of paper is constructed with heavy box section steel side frames, adequately braced and carried on soleplates. Two 12-in. diameter winding drums, mounted in ball-bearing housings, are fitted, and these are connected by gears and driven through a worm reduction gear. A pair of sliding bearings for carrying the rewinding shaft is fitted to machined vertical guides on the framing, and to these are attached racks engaging with pinions on a cross shaft at the top of the framing. Brake gear is fitted to this cross shaft to increase the winding tension in the reel, and a ratchet and pawl gear, foot operated, is also fitted to retain the bearings in their " up " position when changing reels. The racks and bearings are counter-balanced by means of weights and cables within the framing.

A slitting attachment is furnished for trimming the edges or for cutting the reel into narrower reels, and comprises three pairs of shear-type slitting knives similar to those mounted on the laminator. The lower knives are fitted on a driven shaft, and the upper knives are mounted on a cross bar with individual adjustment and disengaging levers.

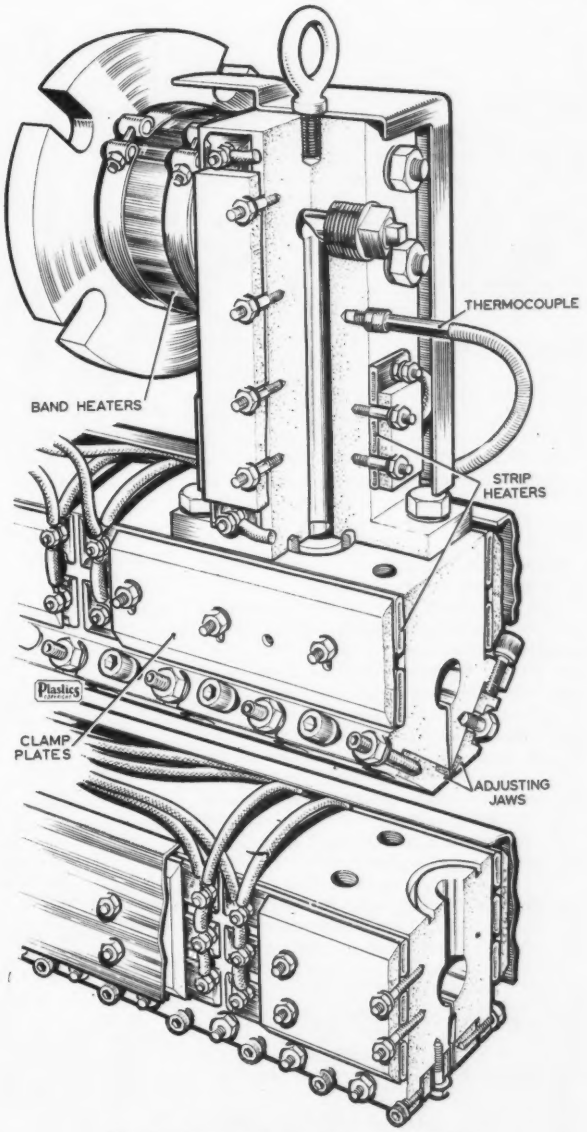
Six-inch-diameter idler rolls are mounted on the winder frame in self-aligning ball bearings. A bowed spreader roll is also fitted to spread the web free from creases. In addition an adjustable bowed bar is located within the framing between the last idler roller and one of the winding drums.

A wood unloading table mounted on brackets at the front of the winder and supports are provided for make ready re-reel shaft.

An operator's control panel is also provided on which is fitted the control gear for the extruder, the machine motor centrifugal circulating pumps, extruder tachometer and ammeter, machine speed tachometer and motor ammeter, temperature indicating dials and control gear for pre-heating rolls, and push-button control pneumatic cylinders for " in " and " out " positions.

Die

For paper coating, a special form of die is provided with protruding lips enabling the die to be fitted well down into the nip of the laminating roll. It is constructed of carbon steel with adjustable jaws having stellited lips, and is electrically heated by strip heaters. The die is connected to the extruder by means of an adaptor flanged to suit the extruder barrel flange. Strip heaters are also fitted to the adaptor.



The die shown at the top is for paper-coating. Underneath is a die for film extrusion.

Temperature control to the die and adaptor is by means of six of the proportioning type controllers fitted in the control panel, one controlling the heaters on the adaptor; the heaters on the die are divided into five zones each controlled by its own controller.

Adequate adjustment is provided so that the width of film being extruded may be varied to suit the width of paper, foil or film being coated.

Reference should be made to the drawings above, which show cut-away sections of typical dies. Band and strip heater positioning can be seen, as well as the location of the thermocouple. The screw adjustment method of opening and closing the jaws is also clearly shown, providing for very accurate control of nip width.

Also illustrated is a sheeting die for film manufacture. This is similar to that described above excepting that the die jaws oppose each other horizontally and extremely fine adjustments can be made to the jaws to ensure even gauge of film.

In conclusion, we wish to thank the staff of Bone Brothers, Ltd., who have rendered great assistance in the preparation of this report.

New Productions

Gift Casket

A smart and attractive gift casket is now being moulded by E. K. Cole Ltd., Southend-on-Sea, in ivory urea material. The casket has a flush fitting lid with a circular inlay carrying an "English Rose" motif moulded into its centre. The inside of the casket is lined with clear polystyrene. The casket measures 7 in. long by 3½ in. wide by 2¼ in. deep.

Moulded gift casket by E. K. Cole Ltd.

Fume Cabinet

Designed principally to obviate the toxic and corrosive effects of perchloric and hydrofluoric acids, the latest fume cabinet constructed by Turner and Brown Ltd., Davenport Street, Bolton, Lancs, is constructed from rigid p.v.c.

The main structure of the cabinet is in B. X. Cobex rigid vinyl tube reinforced with metal.

Rigid ⅛-in. p.v.c. sheet is employed to form the side and back panels.

A stainless-steel tank can be incorporated to form the working level. The tank is insulated from the p.v.c. with glass wool, and bunsen burners and hotplates may be used with complete safety. A water feed irrigates the tank to a depth of ⅛ in., fumes from the cabinet are drawn through bottom extract ports to a p.v.c. fan, and in the case of perchloric acid the ducts may be sprayed with water to eliminate build up and risk of explosion.

A totally enclosed fluorescent light fitting and control gear is provided.

The sliding sash is manufactured from transparent p.v.c. adequately reinforced, the sash is raised and lowered by Terylene cords working on p.v.c. pulleys and counter-balanced by lead weights in a tubular p.v.c. housing.

Moulded Key Fob

Designed and also marketed by Elk and Co. Ltd., Hampton Court Parade, East Molesey, Surrey, who specialize in the manufacture of business gifts, the key fob we illustrate has been moulded in polystyrene. The fob has been designed as an advertising gift for car owners, and different registration numbers can be incorporated by raising the transparent window and threading the printed strips through the apertures. When the window is pressed home the unwanted parts of the strips are cut away.

The moulding is being done by Godfrey Holmes (Plastics) Ltd., Wragby, Lincs, from tools supplied by Elk and Co. Ltd.

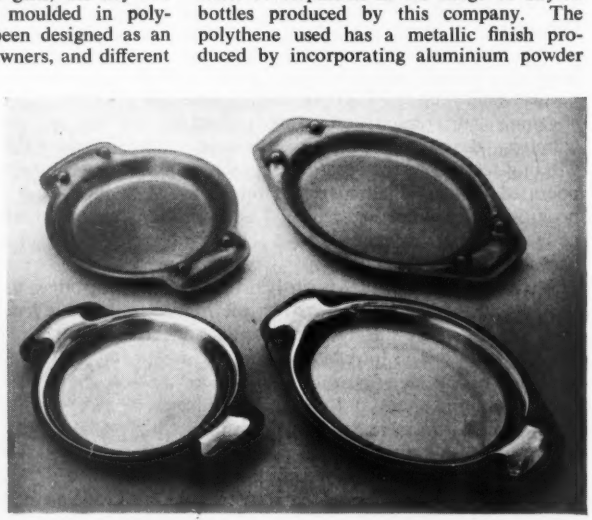
Skillet Holders

Glass reinforced plastic has been used in the manufacture of the skillet holders we illustrate here. These mouldings are probably the first instances where glass fibre reinforced materials have been used in the hotel and catering trades. Designed for carrying steel skillets which have been kept on a hot plate, the heat-insulating properties of the glass fibre enable the comfortable handling of the hot skillet. The holder is manufactured by Universal Metal Products Ltd., Langley Road, Salford 6, Lancs.

Polythene Cycle Flask

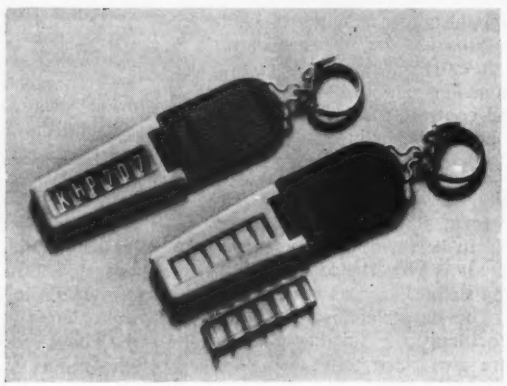
Moulded in polythene by Fibrenyle Ltd., 157 Dukes Road, Western Avenue, London, W.3, the water flask illustrated is one of the latest developments in the range of Skylon bottles produced by this company. The polythene used has a metallic finish produced by incorporating aluminium powder

(Right) Skillet holders moulded from glass reinforced plastics by Universal Metal Products Ltd.

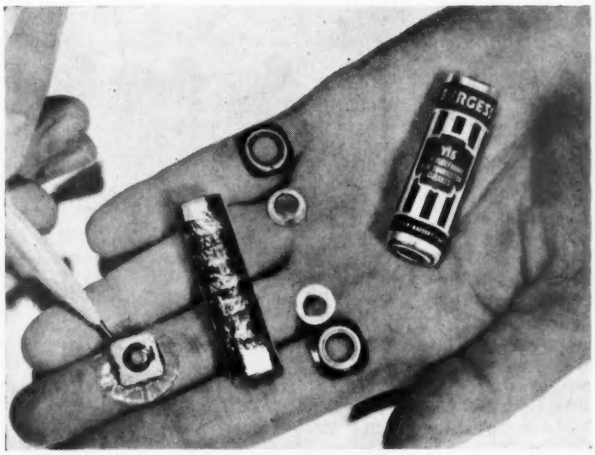


(Left) Fume cabinet constructed from rigid p.v.c. by Turner and Brown Ltd.

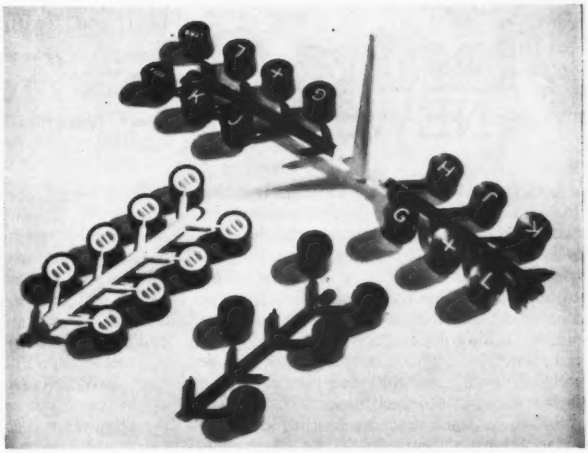
(Below) A key fob in polystyrene moulded by Godfrey Holmes (Plastics) Ltd. for Elk and Co. Ltd.



(Bottom right) A polythene cycle flask moulded by Fibrenyle Ltd.



New small dry battery using polyester film as a cell-wrapping material.



Two shots showing the stages in the manufacture of teleprinter keys by double moulding.

in the material. Besides the natural silver-grey colouring it is possible to produce bottles in different metallic colours.

New Dry Battery

Recently developed in the U.S.A., by Burgess Battery Company of Freeport, Illinois, is the wafer cell dry battery. The new cell which makes possible a 30% increase in battery power and life consists of a sandwich of artificial manganese dioxide mix between discs of flat-zinc and carbon electrodes. Each cell is sealed in a pliofilm envelope .0015 in. in thickness. Fifteen of such cells are stacked to form a battery or part of one. This cell stack is wrapped in Mylar, polyester film which gives a good insulating effect, is space saving, and facilitates quality inspection. The final wrapping is a drawn aluminium tube into which the stack is compressed. A fifteen-cell 2 in. stack as described produces a 22½-volt. battery for pocket radios, hearing aids, and other small electronic devices. The U200 battery made up from similar cells provides over 300 volts in less than 20 cubic inches of space.

Insulating Nipple

Conex-Terna, Ltd., of Conex Works, Whitehall Road, Great Bridge, Tipton, Staffs, have now introduced to their range of plumbing fittings a p.v.c. insulating nipple for connecting copper waste pipes and galvanized steel or cast iron stack pipes, to meet the requirements of some water boards who insist on non-metallic connections owing to the electrolytic action which takes place with two dissimilar metals. The fitting is available in 1¼ in. and 1½ in. with B.S.P. taper threads. The nipple is made from rigid p.v.c. extruded tubing with a mechanically cut taper thread.

Model Lifebelt

Sold principally as souvenirs these model lifebelts are popular on many of the well-known passenger liners belonging to the Cunard White Star, Orient Line, Union Castle and Canadian Pacific. Passengers travelling on the liners of these companies may purchase the lifebelts suitably inscribed with the name of the ship upon which they are travelling.

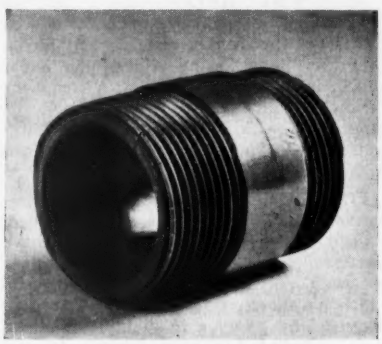
The lifebelts are moulded in Beetle X grade moulding powder by J. Thwaites, Playrite Nursery Toys, Ltd., for Tudor Plastics of Bradford. Beetle moulding powder is made by British Industrial Plastics, Ltd.

Teleprinter Keys

Employing a double moulding technique, the teleprinter keys illustrated provide an excellent example of high-quality moulding by a company whose principal product is unconnected with the plastics industry. Creed and Co., Ltd., of Croydon, mould these keys for their new model 54-page teleprinter. The mouldings made from two grades of Bexoid cellulose acetate moulding powder are completed in two stages. The first stage is the moulding of the dark green "base." The powder used has a high acetyl value giving it a higher flow temperature than the white acetate used in the second stage, which in this case has a low acetylation figure. The second moulding operation as can be seen from the photograph "fills in" the figures by using the same runners as the green. Although the keys themselves may appear overshadowed by some of the more eye-catching articles which appear on these pages, the skill and ingenuity which must have gone into the tool design and production technique for these mouldings can only reflect the highest credit on the companies concerned in their manufacture.

Laminates in Wimpy Bar

The third of the well-known Lyons Wimpy bars was opened recently within one of their teashops at 101 Finsbury Pavement. In the design by Sir Hugh Casson, Warerite panelling covers three walls of the bar and a special feature is the blue line drawings representing the origins of Wimpys, which are incorporated in the panels. The murals were designed by Sir Hugh Casson and Miss Sheila Stratton.



A turned p.v.c. insulating pipe nipple.

Model lifebelt moulded as souvenirs on passenger liners.

New Wimpy bar with decorative laminates incorporated.

Plastics NEWS

Plant and Equipment, Materials, Processes, Company News, Technical Literature, Exhibitions, Personal Notes, and Meetings.

LARGE VACUUM FORMER.—The Auto-Vac Company of Bridgeport 5, Connecticut, U.S.A. has announced the development of a vacuum-forming machine designed specifically for the lighting industry. This automatic machine has a maximum forming area of 50 in. × 50 in., which will produce plastic ceiling pans up to 4 ft. square economically. The clamping frames are fully adjustable so that the producers can form single, double, or four 2 ft. × 2 ft. pans on the same machine by simple adjustments. Manufacturers can utilize either sheet plastics or rolls. High-speed production rates of better than 400=2 ft.×2 ft. pans per hour are reported possible.

to one pound per square inch. This high sensitivity is obtained by mechanically coupling a large synthetic rubber diaphragm to the spool of the control valve. The pilot inlet connection is ⅛ in. B.S.P.

The system of unit construction on which this company's range of equipment is based makes it possible for the diaphragm-operating mechanism to be fitted to ¼ in. and ⅜ in. bore, two-, three- and four-way valves.

The most common combination is to fit the diaphragm mechanism at one end of the valve and a return spring at the other. The other end of the spool can, however, be fitted to any other of the 20 other standard operating mechanisms, including the diaphragm.

(Left) The new Auto-Vac vacuum former designed for the lighting industry.

(Right) The Shaw moisture meter.

VACUUM FORMING SECTION.—As a result of recent approaches made to it, the British Plastics Federation is considering the formation of a new Section to cover the vacuum forming side of the industry. In order to obtain the views of all concerned, the Federation has arranged an ad hoc meeting of all those interested, whether members or not, to be held at the headquarters of the Federation, 47-48 Piccadilly, London, W.1, on Tuesday, May 15, 1956, at 11 a.m.

A cordial invitation is extended to all interested whether they be vacuum formers, material suppliers or machinery manufacturers. Those proposing to attend are asked to advise the Federation in advance. The chair will be taken at this meeting by Mr. C. L. Malcomson, a member of the Executive Committee of the Federation and chairman of the Fabricators Group.

DIAPHRAGM-OPERATED CONTROL VALVES.—To meet the needs of process control systems where the pressure of the air supply is very low, Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent, have produced an operating mechanism which is sensitive to air pressures down

SPECIALITY NYLON MOULDING POWDER.—A "moly-sulfide" filled nylon moulding powder, trade-marked Nylatron GS, is described in a new bulletin available from Polypenco, Inc., 2150 Fairmont Avenue, Reading, Pa., U.S.A. The bulletin explains how the field for moulded nylon applications is expanded due to the superior wear and frictional properties of Nylatron GS, along with its resistance to heat distortion and expansion. Test data are included. The compounded powders are reported to be readily mouldable in equipment used for standard types of nylon.

Owing to the printing dispute in London, publication of *Plastics* had to be suspended and the present is the first issue since the February number.

The validity of all current subscriptions to the journal has been extended to allow for those issues which failed to appear. The current number, although combining the March, April and May issues, is being counted for subscription purposes as one issue only.

The Bullows moisture and oil remover for air lines.

OIL AND WATER SEPARATOR FOR AIR LINES.—Alfred Bullows and Sons, Ltd., Long Street, Walsall, Staffs, have recently produced a separator which has been designed so that it completely removes oil from air lines at temperatures up to 300° F., and water from lines where condensation has taken place.

The new separator consists of banks of long fibre felt pads, which have been specially produced for this duty. These pads become wetted by the passage of contaminated air, and cause the very fine particles of oil and water to coagulate, so that the oil and water are easily separated from the air.

The filter is self cleaning and discharges collected oil and water through an automatic valve, so that it will operate for long periods without any attention, and without the filtering medium becoming saturated. It is available for wall mounting in two sizes, the E.200 with a capacity of 20 c.f.m. at 100 p.s.i. and the E.250 with a capacity of 65 c.f.m. at 100 p.s.i.

MOISTURE METER.—Latest addition to the range of moisture meters produced by Shaw Electronics, 31 Market Street, Bradford, Yorks, is the Wide Range Super which, it is claimed, works at a frequency far higher than any other type of meter. Its range is from complete dryness to 100% water and the moisture content is obtained by a direct reading from the dial.

POLYESTER COLOUR PASTES.—Reeves and Sons, Ltd., Lincoln Road, Enfield, Middlesex, announce that they have now available a range of colour pastes for use with polyester resins. The pigments which have been fully tested are normally dispersed by grinding in dibutyl phthalate. It is estimated that approximately 5% by weight will be required.

General

Particle Accelerator. British Insulated Callender's Cables, Ltd., are now installing a 2-million-volt particle accelerator at their Research Laboratories at 38 Wood Lane, London, W.12. This is one of the first particle accelerators to be installed in the United Kingdom for purely industrial researches.

The accelerator is of the Van de Graaff type, housed within a pressure container operating at about 300 lb./sq. in. It is a universal apparatus which can be adapted to supply high energy beams of electrons, positive ions, neutrons or gamma rays.

The installation will be used for general research into the effects of high energy irradiation on materials used in cable and capacitor manufacture. In particular, it will be employed for continuing the researches on the effect of irradiation on polyethylene, on which the company has carried out considerable work during the past few years.

Cable Eccentricity Gauges. The Addison Electric Co., Ltd., 10-12 Bosworth Road, London, W.10, have recently introduced a new range of equipments operating on a capacitive principle. These instruments are capable of indicating the degree of eccentricity of the conductor inside the dielectric sheath of plastic- and rubber-covered wires and cables, from 0–3.5-in. overall diameter, and they are direct reading.

"Internal Carving of Perspex." Illustrated by photographs of examples of this work this booklet published by I.C.I. describes both the tools required and the technique used in producing these carvings. Copies can be obtained from I.C.I. Plastics Division, Black Fan Road, Welwyn Garden City, Herts.

New Hydraulic Press for Formica Laminates. The new 6,100-ton hydraulic press for the production of laminated plastics, is now in operation at the Tynemouth factory of Thomas De La Rue and Co., Ltd. The new press permits the manufacture of sheets up to 10 ft. by 4 ft., which it is anticipated will provide greater scope and prove more economical as its proportions will allow a greater number of useful panels to be produced from it without wastage.

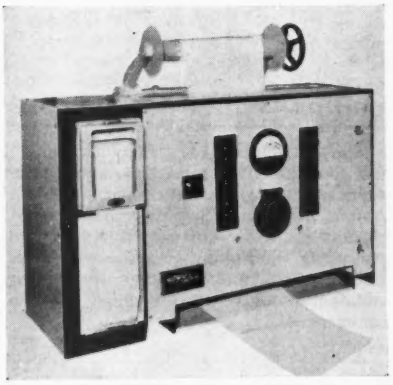
New Research Laboratories at the Newport, Mon, factory of Monsanto Chemicals, Ltd., were officially opened on April 17, by Sir Cyril Hinshelwood, President of the Royal Society, in the presence of many distinguished scientists, including representatives of government, academic and industrial research laboratories and organizations.

They were named the Rideal Laboratories in honour of Professor Sir Eric Rideal, F.R.S., consultant to, and until recently a director of, Monsanto Chemicals Ltd., who was present at the ceremony.

The laboratories have been designed to augment the already extensive research facilities of the company located at the Nickell Laboratories, at the Ruabon, Denbighshire, factory, and the applicational research laboratories at Fulmer Hall, Buckinghamshire. Primary function of the new laboratories will be to seek means of improving products and manufacturing processes and, by developing new products, to diversify operations, both at Newport and elsewhere.

An important feature of the Rideal Laboratories is the specially equipped radiation laboratory, housed in a separate building, which represents a major departure from conventional research into a new and highly speculative field of chemistry. Further details of this new laboratory will be published in the June issue of *Plastics*.

New American Resin. Food Machinery and Chemical Corporation (Chemical Divisions), New York, have recently produced a new type of resin. It is reported as being a solid pre-polymer of diallyl phthalate, with exceptional electrical properties. Other applications visualized for it are in the decorative laminate field. It is being marketed under the trade name of Dapon.



A self-contained transverse profile gauge made by Baldwin Instrument Co., Ltd.

Transverse Profile Gauge. Latest development in the field of nucleonic thickness gauges is a transverse profile gauge for measuring transverse weight variations of paper, board and plastics which is being produced by Baldwin Instrument Co., Ltd., Brooklands Works, Dartford, Kent. This is a completely new version of the Atomat Beta Ray Thickness Gauge, in that the instrument is fitted with its own amplifier making it completely self-contained. The principle upon which it works is the same as that used for the beta ray gauge.

Another recent introduction by this company is an **electro magnetic pilot valve** of the "glandless" poppet type employing a new type of actuator. This valve, of which there are two types, can, it is claimed, handle fluids at higher pressures and flow rates than has previously been possible.

Copper/Fluorocarbon Laminates. A report from the U.S.A. announces that the International Resistance Co., 401 North Broad St., Philadelphia 8, Pa., have produced a new laminate for use in printed circuitry. By using a bonding technique which does not employ a resin adhesive, successful laminating of copper to polymonochlorotrifluoroethylene has been carried out. The laminate is recommended for use under severe temperature, moisture and electrical conditions.

In the June, 1955, issue of *Plastics* we mentioned the development of metal-clad polytetrafluoroethylene by Edison Swan Electric Co., Ltd., for use in the radio and electronic industries.

Brazilian Polyethylene Plant. New York, January 20.—Plans for the construction of a polyethylene plant in Brazil have been announced by the President of Union Carbide and Carbon Corporation. This latest addition to Union Carbide's group of overseas polyethylene plants will be erected and operated by a wholly owned subsidiary of the Corporation, Union Carbide do Brasil, S.A.

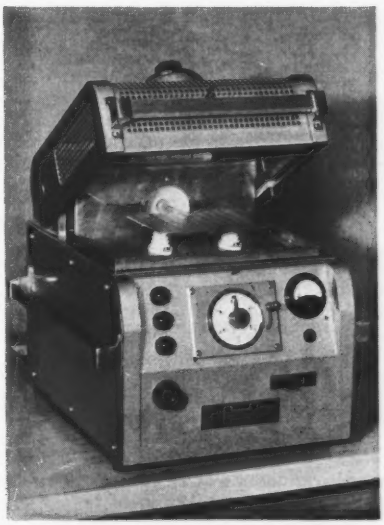
The new polyethylene plant will be located at Cubato, near Santos. It will be adjacent to the refinery and ethylene plant of Petrobras, the Brazilian Government agency that controls the major refining operations in that country.

The Union Carbide plant will have sufficient capacity to satisfy completely the most optimistic estimates of Brazil's polyethylene requirements over the next five to ten years. It will be so constructed that its productive capacity can be increased at any time by making relatively simple additions and minor alterations.

Styron 475 for Battery and Cell Containers. British Resin Products, Ltd., announce that Styron 475, which is now in production at Barry, Glamorgan, has been specifically approved by the Ministry of Supply for use in the manufacture of battery and cell containers.

Post-forming Formica. The new post-forming grade of Formica is now available in all the colour and patterns of the Formica range with the exception of directional wood grain and the new plain colours.

Design Centre Exhibits. Among the consumer goods which have been selected by the Council of Industrial Design for exhibition at their new premises are many



The Herfurth H/F pre-heater which was shown at the recent Hanover Fair. It is manufactured by Herfurth G.m.b.H., Hamburg-Altona.

designed and manufactured in the plastics industry. Lacrinoid Products, Ltd., Thermo-Plastics, Ltd., Progressive Inventions, Ltd., Brookes and Adams, Ltd., Halex, and Rotaflex (Gt. Britain), Ltd., are a few of the companies whose products are to be shown. In addition, various radio and television manufacturers have had sets which incorporate plastics in their housing, selected for display.

Production of Furoic Acid. Howard Lloyd and Co., Ltd., Batley, Yorkshire, announce that they are now producing Furoic acid. Reported as being the first time it has been manufactured in Great Britain on a commercial scale, Howard Lloyd are marketing two grades. The first is a high quality technical grade containing not less than 98% Furoic acid, and the second is a re-crystallized grade containing not less than 99.8% Furoic acid. Furoic acid has a molecular weight of 112 and a melting point of 133° C.

Furfural, an agricultural by-product, has a molecular construction whereby the aldehyde group is attached to the Furon ring. Further oxidizing yields Furoic acid containing the acidic group attached to the Furon ring.

Duty-free Licensing of Machinery. The Board of Trade announce that in connection with applications under Section 10 of the Finance Act, 1932, for the remission of the duty which is normally chargeable on imports of machinery, the following conditions will now require to be met on applications where it is claimed that the delivery by manufacturers in the United Kingdom of similar machines is unduly protracted.

The user of the machine submits evidence to show that when he placed the order for the foreign machine:—

(a) no manufacturer in the United Kingdom of similar machines could deliver within two years; and

(b) that in cases where delivery by United Kingdom manufacturers was:—

(i) between 24 and 30 months, the foreign delivery was within 15 months; or

(ii) more than 30 months, the foreign delivery was within one half of the period.

Licences issued on these grounds will be valid until 15 months from the date of the user's order for the foreign machinery or half the period required for delivery of similar United Kingdom machinery, whichever is the greater, and the period of validity of these licences will *not* be extended.

Federation Annual Report. The annual general meeting of the British Plastics Federation was held on March 21. Mr. Cyril Last, a director of Bakelite Ltd., was elected chairman. Mr. N. B. Punfield, was elected vice-chairman and Mr. Charles Waghorne was re-elected president.

From the president's address, the following paragraphs are extracted as being of special interest to readers of *Plastics*.

"Firstly, I suggest that a Council of 42 which excludes ex-officio members is somewhat large out of a membership of 300 companies and consideration might be given to reducing its number.

"Secondly, I do not think it is adequately realized that among the 300 member companies are some whose activities and interests are wholly in the plastics industry while others have only a marginal interest.

"While there are hundreds of companies who are not members of the Federation and have some interests in the plastics industry, it is true to say that the Federation represents almost 100% of those firms whose sole interest is in the industry. I feel that in the long run, the necessary finances of the Federation must very largely be supplied by those firms who are solely interested in the plastics industry. I also suggest that the control of the Federation's activities must also be largely in their hands."

P.I.G.S. Results. The 1st Meeting of the P.I.G.S. London Section 1956 Season took place at Hendon Golf Club on Thursday, April 19. The results were:—

"Robert Hartley" Prize (Medal Round): R. P. Anderson, 80 gross − 12 = 68 net. Runner-up: G. H. Clement, 94 gross − 24 = 70 net. Austerity Cup (scratch): C. Parkinson, 78 gross.

"Arrow Electric Switches" Trophy and "Steuart Trophy"—Stableford Bogey Greensomes: P. Smith and J. Selby, 34 points. Runners-up: D. Radford, C. Parkinson, 31 points.

Company News

British Celanese, Ltd., announces that it will in future be marketing a range of chemicals under its trade mark "Syncel." Among products in the range of "Syncel" chemicals are the company's trichlorethylphosphate and vinyl acetate monomer. Bulk production of the latter, which is an addition to the company's range, has now commenced.

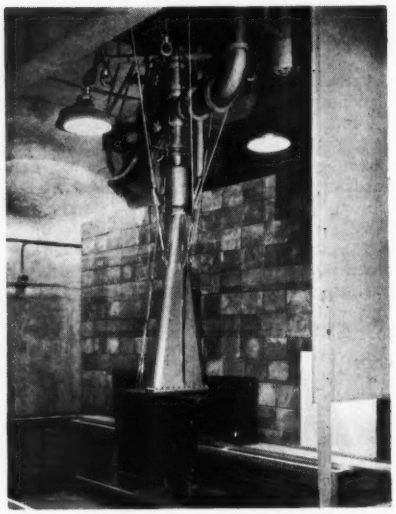
A. Boake Roberts and Co., Ltd., announce that it has been mutually agreed that Coalite and Chemical Products, Ltd., of Bolsover, Derbyshire, will take over the manufacture and distribution of Catechol.

W. R. Grace and Co., of New York, announce that they are to construct a million dollar semi-works plant for polyethylene and other polymers by processes licensed from the Phillips Petroleum Company. The plant is to be constructed on a site near Baton Rouge, Louisiana.

Hoescht Chemicals, Ltd., have opened a branch office in Manchester at 75 Piccadilly, Manchester, 1. Phone No. Central 2234/5. Mr. R. G. Howell will be in charge.

E.P.S. (Research and Development), Ltd. As from April 1, 1956, the Research and Development activities of Export Packing Service, Ltd., have been taken over by a subsidiary company known as E.P.S. (Research and Development), Ltd. The directors of the new company are: Mr. R. G. Boucher (managing director), Mr. E. C. Boucher, Mr. D. Gonda, and Mr. E. V. Norcock.

Imperial Chemical Industries, Ltd., have received the approval of the Government of India to a project to manufacture polythene in India. The manufacture will be undertaken by I.C.I. associate, The Alkali and Chemical Corporation of India, Ltd., in which the Indian public has a substantial shareholding.



Radiation scanner in the Van de Graaff room at Hinxton Hall laboratories of T.I.

T. I. Research Enters Irradiation Field. As part of the Hinxton Hall fundamental research unit of Tube Investments Ltd., near Cambridge, a high energy radiation laboratory was recently opened, equipped with a Van de Graaff generator capable of producing a two million volt beam of radiation at high intensity. These instruments will be used to investigate the behaviour of high polymers both during and subsequent to irradiation. A more detailed analysis of the significance of this equipment will be published next month.

F. G. Miles, Ltd., announce the formation of a new company to be known as Miles Structural Plastics, Ltd. The new company has a nominal capital of £10,000 and takes over all the activities of the plastics division of F. G. Miles, Ltd. It will be principally concerned with the development and production of Durestos mouldings and constructions.

Staatsmijnen to Produce Polyethylene. Staatsmijnen in Limburg have decided to go into production of polyethylene by the Ziegler process for which they have bought the licences for the Benelux union. For this purpose a new factory is being constructed at Beek, which will probably be completed towards the end of 1957.

Plastanol, Ltd., Crabtree Manorway, Belvedere, Kent, announce that their bulk production unit for the manufacture of phthalic anhydride is in full production. In addition to covering their own requirements for the production of the Plastokyd alkyd resins a substantial quantity is available for sale.

West Instrument, Ltd., have moved to new premises at 52 Regent Street, Brighton, 1. Phone, Brighton 28106.

Literature

Polyvinylpyrrolidone. British Oxygen Chemicals, Ltd., have recently commenced production on a semi-commercial scale of polyvinylpyrrolidone in two grades, as a 30% aqueous solution and as a spray dried

solid. Both grades are of K value 30-35. A technical bulletin has been published.

P.V.C. Flooring. The British Plastics Federation has prepared a specification for p.v.c. flooring which has been sent to the British Standards Institution for consideration as a draft British Standard.

The recommended specification covers all types of p.v.c. flooring supplied in continuous lengths and in tile form and, in addition to specifying the material to be used, lays down methods of test for dimensions, dimensional stability, loss of weight on heating, resistance to moisture, curling, primary indentation, residual indentation, flexibility, impact strength and resistance to flammability. There are also clauses covering the thickness of the "wear layer" and "ply adhesion" for laminated flooring.

Amended Standard. B.S. 771, Synthetic resin (phenolic) moulding materials has an amendment to the method of determining the percentage of acetone soluble matter.

In the new method the percentage of acetone soluble matter is calculated from the weight (after evaporation of solvent) of the resinous material which is extracted. This removes the necessity of completely drying the powdered moulding before it is weighed and extracted, thereby saving 24 hours of valuable time.

The May issue of "Nuclear Engineering."

New Monthly Journal. The first number of a new monthly industrial journal, *Nuclear Engineering*, was published last month by Temple Press Ltd. Covering all phases of world industrial production and utilization of nuclear energy and its by-products, the new journal is designed to meet the requirements of potential users of nuclear energy as well as manufacturers of plant and equipment, and to provide an authoritative commentary on the growing influence of nuclear energy and its applications in different fields.

In the May issue, published on May 7, Dr. J. M. Kay writes on the Economics of Nuclear Power, and R. F. Jackson, Deputy-Director (Engineering) A.E.R.E. Harwell, on the Harwell Experimental Reactors. Other important features of this issue include an article on Zirconium Production by Dr. G. L. Miller, an account of the Fabrication of Heavy Plate Structures by J. McLean, and the second of an exclusive series of "cutaway" drawings depicting representative types of reactors.

Nuclear Engineering costs 3s. 6d. a copy, or by subscription, 42s. a year post free, and is obtainable from newsagents or direct from the Publishers.

Index for *Plastics*. The index for Volume 20, January to December, 1955, is now available. Copies can be obtained from Temple Press Ltd., Bowling Green Lane, London, E.C.1, price 4d. to cover postage and packing.

Exhibitions

R.E.C.M.F. Exhibition. The Radio Components exhibition this year provided little new in the use of plastics materials. Developments reported in the past few years are now established and in general use. Features such as the injection-moulded radio cabinet, the polystyrene transistor, epoxy casting resins and printed circuits (now in a flexible grade) were a few of the many examples of the use of plastics which were shown.

The Physical Society's Exhibition is to be held at the Royal Horticultural Halls from May 14-17. A comprehensive display of new and established instruments, equipment and apparatus will be shown.

International Instrument Show. — The second of these shows is being held at Denison House, Victoria, London, S.W.1, from May 7-18. Most aspects of instrumentation are covered, especially precision measurement in the microwave, audio and chemical field. Over 40 companies are represented.

Mechanical Handling Exhibition.—Held at Earls Court from May 9-19 will again feature many of the methods of handling for bulk and individual components.

Production Exhibition. Mr. Iain McLeod Minister of Labour and National Service, will open the 1956 Production Exhibition to be held at Olympia from May 23-31. Sir Leonard Lord, K.B.E., President of the Institution of Production Engineers, will be President of the exhibition.

Conferences

Conference on Injection Moulding. Last Autumn the Plastics Division of Imperial Chemical Industries, Ltd., issued a technical bulletin entitled "The Principles of Injection Moulding" which deals in a scientific but simple manner with the requirements for making good mouldings and with the reasons for common faults and with their cures. This publication has been so well received by the industry that I.C.I. decided to expand this approach to injection moulding problems by holding a series of conferences with operatives from moulding firms. The first two of these were held on January 26 and February 24 in the Technical Service and Development Department laboratories of the Plastics Division at Welwyn Garden City.

I.C.I. had prepared a detailed programme of talks by members of the staff and laboratory demonstrations. The talks, illustrated by lantern slides and samples obtained from the trade and matched by others made in the I.C.I. laboratories, were designed to amplify the information contained in the bulletin "The Principles of Injection Moulding." The whole conference was informal in character, and after each talk and demonstration there was a lively and interesting discussion to which the guests contributed freely in the light of their experience in production shops.

The simple logical approach adopted, backed as it was by experimental evidence, helped to put the moulding process and its difficulties into perspective and the explanations of the carefully planned experimental programmes carried out by I.C.I. enabled the production moulders to form a clear picture of the relationship of many of their day-to-day experiences which they have not the time to investigate.

One of the most valuable parts of the conference was the contribution made by the guests in the discussions. Many raised problems of their own which were found to be of general interest, and the pooling of all the experience available round the table was of considerable assistance to everyone.

The demonstrations, using "Maranyl" nylon, "Diakon" acrylic powder and "Alkathene" polythene, were the more appreciated for being carried out on 2-oz. and 8-oz. machines, similar to those used in everyday production work.

Each visitor was given a booklet containing summaries of the talks given by the I.C.I. staff, and reproductions of the slides used during the day, a most useful source of reference.

The first two conferences were attended by moulders from in and near London. Firms in the Midlands, the North and Scotland will be invited to attend future conferences and any firm particularly interested in this scheme is invited to ask for further details from the nearest I.C.I. Sales Office.

International Congress of Surface Activity. The second Congress will be held in London from April 8-12, 1957, with Lord Brabazon of Tara as the President of Honour and Professor Sir Eric Rideal as the President.

An Organizing Committee has been set up under the Chairmanship of Dr. Leslie H. Lampitt and with Sir Charles Dodds as Honorary Treasurer and Lt.-Colonel Francis J. Griffin as Honorary Secretary.

Membership of the Congress is open to all interested persons on payment of the membership fee of £4. All inquiries should be addressed to: The Honorary Secretary, 2nd International Congress of Surface Activity, 14 Belgrave Square, London, S.W.1.

The International Mechanical Engineering Congress will be held in Paris from June 4-9, 1956. Copies of the programme and further information can be obtained from the British Engineers' Association, 32 Victoria Street, London, S.W.1, which is the U.K. sponsor of the Congress.

"Plastics in Building" will be the subject of a two-week Special Summer Programme to be given at the Massachusetts Institute of Technology from July 2-13 during the 1956 Summer Session.

The Programme will study plastics and

their growing use in buildings, as exemplified in the design and detailing of a small residential structure.

Personal

Air Chief Marshal Sir John Nelson Boothman, K.C.B., K.B.E., D.F.C., A.F.C., F.R.Ae.S., who is 55, joined the Board of Kelvin and Hughes, Ltd., as Technical Sales Director on May 1.

Sir Miles Thomas is to become chairman of Monsanto Chemicals, Ltd., in succession to Mr. E. A. O'Neal, Junr.

Sir Ben Lockspeiser has joined the Board of Tube Investments, Ltd., and has been appointed Scientific Adviser to the Tube Investments Group. Sir Ben recently retired from the Department of Scientific and Industrial Research.

Mr. Thomas W. Howard has succeeded his cousin, the late Mr. Geoffrey E. Howard, as chairman of Howards and Sons, Ltd., and Howards of Ilford, Ltd.

Mr. C. H. B. Rutteman, managing director of Hercules Powder Co., Ltd., has been appointed chairman of the board of the British company. **Mr. H. E. Hartzell,** who has been a director for the past five years, will take office as managing director.

Three new directors have been appointed, namely **Mr. T. E. Breakell** (secretary), **Mr. E. F. Parker** and **Mr. C. R. Colman.**

Mr. S. Bradley has been appointed director of Plastocraft Products (Darwen), Ltd.

Mr. H. S. Payman and **Mr. F. J. Kennard** have been appointed to the board of Suflex, Ltd. **Mr. L. E. Robinson** has been appointed sales manager.

Mr. R. J. Southwell was named president and a director of Canadian Resins and Chemicals, Ltd. He succeeds Mr. Victor G. Bartram, who has retired.

Mr. A. E. Lever, consultant and visiting lecturer to the National College of Rubber Technology, informs us that his telephone number is now Lingfield 463.

Mr. C. J. G. Stanley, manager of the British Plastics Federation and **Mr. B. C. Aldis,** assistant to the director, have taken over the duties of Dr. W. E. de B. Diamond, who recently relinquished his position as director.

Mr. J. Tough has been appointed general sales manager and **Mr. D. S. Stephens, M.Sc.,** has been appointed chief technical manager of Ashdowns, Ltd. Mr. R. A. Parkin continues as works manager.

Mr. C. W. Hotchen has been appointed works manager (production) at the factory of Smiths Aircraft Instruments, Ltd. The post is a new one.

Mr. M. O. Rowlands has been appointed head of the new industrial design studios set up by E. K. Cole, Ltd., at Southend-on-Sea.

Mr. R. F. Archer has been appointed joint general manager of the Micanite and Insulators Co., Ltd. He will share managerial responsibilities with **Mr. H. A. Cooper,** director and general manager. **Mr. A. N. Hawthorn** and **Mr. J. P. Corkhill** relinquish the positions of chief chemist and works superintendent respectively to become assistant works managers.

At the annual luncheon of the Midlands Section of the Plastics Institute. Left to Right are: Mr. E. L. Merritt, Mr. E. M. Clayson, Mr. C. C. Last, and Mr. H. H. Lusty.

Mr. J. W. Wooley has been appointed manager of the new branch office of Tufnol, Ltd., at Exchange Buildings, Quayside, Newcastle-on-Tyne, 1.

Lord Selsdon and **Mr. B. Jablonsky** have resigned their directorships of Hydulignum-Jabroc (Tools), Ltd., and Jabroc, Ltd., both fully controlled subsidiaries of Permali, Ltd.

Mr. J. L. Armstrong, finance director, has retired from the Board of Imperial Chemical Industries, Ltd. **Mr. P. T. Menzies** has been appointed an additional director as from February 24 and has taken over the duties of finance director.

Mr. W. W. Watt, who has been a Managing Director of The British Oxygen Co., Ltd., since 1938, retired on March 31.

Mr. E. Hagen has resigned from his position as sales director of Utilex, Ltd.

Mr. T. H. Windibank. The Directors of Crompton Parkinson, Ltd., announce with regret the resignation of Mr. T. H. Windibank from the board of the company as from March 31, 1956. Mr. Windibank has been associated with the company for 33 years and he has been a director of the company for the past 17 years.

Mr. Michael H. L. Lewis, M.A., has been elected a director of Crompton Parkinson, Ltd. Mr. Lewis has been associated with the Company since January, 1947. He first became a member of the Board of Executive Directors in 1951.

Mr. Michael Parkinson, M.A., has been appointed an executive director of Crompton Parkinson, Ltd.

Mr. H. E. Baum, managing director of Lacrinoid Products presented gold watches to employees who had served 25 years with the company.

Mr. F. M. Roberts, a director of A. Booke, Roberts and Co., Ltd., presented gold watches to 21 employees in recognition of their 25 years' service with the company.

Mr. David Russell, the chairman and managing director of Tullis Russell and Co., Ltd., presented to Miss H. I. Fennell and Mr. G. E. Stimson (London sales manager), on January 25, gold watches in recognition of their completing 35 years' service with the company.

Mr. R. A. Ford. We regret to announce the sudden death of Mr. R. A. Ford, the general manager of Fraser and Glass Ltd. He died on April 14 and was 44 years of age.

Mr. N. C. Robertson. It is with deep regret that we announce the death of Mr. Norman Charles Robertson, C.M.G., M.B.E., Deputy Managing Director of E. K. Cole, Ltd., and a Director of Ekco Electronics, Ltd.

Mr. Robertson, who was 47 years old, died at his home, The Old Vicarage, Burnham-on-Crouch, Essex, on Sunday, April 1.

Mr. H. D. Thurgar. It is with regret that we have to announce the death of Mr. H. D. Thurgar, managing director of Thurgar Bolle (Successors), Ltd. He was 55 years of age.

Mr. R. D. Roberts and Mr. L. A. White. We regret to announce that Mr. R. D. Roberts and Mr. L. A. White, of Bakelite, Ltd., lost their lives when a car in which they were travelling to Aycliffe was in collision with an articulated lorry on the Great North Road near Thirsk on March 15.

Both were well known in the plastics industry. Mr. Roberts, who was Moulding Material Sales Manager, had been with the company nearly 25 years, and Mr. White, who was Moulding Material Sales Manager for the Midlands Area, for nearly 30 years. Mr. White will also be remembered for his work with the Midlands Section of the Plastics Institute of which he was at one time Chairman.

Mr. R. G. Farnsworth, who is in charge of Bakelite, Ltd.'s Moulding Material Sales for the North of England, was injured in the same crash, but he is making satisfactory progress.

Meetings

June

1st.—"Annual Meeting, Luncheon and Works Visit." The Plastics Institute, Western Section, The Longbridge Works of the Austin Motor Co., Ltd. 10.15 a.m.

TALKING SHOP . . .

A Short Trot with Sixteen Cultured Minds. Scattered over Britain are very many people, working for the City and Guilds diploma, and the A.P.I., who cannot get to a centre where facilities for practical experiments exist. The Borough Polytechnic has initiated a series of intensive two-week practical courses, the first of which was held in April. Sixteen members of the industry, from companies as diverse as T.I. Plastics and British Industrial Solvents, moved smartly through 16 experiments. Included were such resin syntheses as urea, epoxy, polyester and melamine; injection and compression moulding; polymerization of vinyl acetate and styrene; extruding p.v.c.

It was my pleasure to spend a day at the Borough whilst the course was in progress. My hat is off to the students, who took full advantage of this valuable opportunity to handle materials and processes which they would not, necessarily, in the course of their everyday work, normally meet. But the real credit belongs to Mr. James Proctor, full-time lecturer in plastics technology at the Polytechnic. Not only was he involved in a tremendous amount of preparatory works, in addition, he kept the course moving smoothly so that each student, in turn, carried out the 16 experiments. By no means an easy task.

Light relief for this heroic group came in the form of a visit to I.C.I.'s plastics division, jointly sponsored by I.C.I. and the London Section of the Plastics Institute.

As participants in what may well be an historic course, the names of the 16 are well worthy of permanent record. Here they are:—G. Brian, A. Worth, C. Williams, D. Greenwood, J. Rodgers, A. Asman, P. Clark, D. Pringle, J. Talbot, D. St. John, K. Jones, J. Wynter, J. Pyne, D. Watson, G. Miles and P. Caldwell.

Second National College Prize Giving. Mr. John Lord, executive director of the Dunlop Rubber Company and chairman of the Rubber and Allied Industries Educational Fund Appeal Committee, presented diplomas and prizes at the Second Convocation of the National College of Rubber Technology on March 22. In full academic dress, the staff of the College walked in procession to the hall of the Northern Polytechnic, where a large audience was waiting. Dr. Cotton, head of the College, reported on the academic year. Following the presentation, visitors toured the College buildings to see the apparatus at work. Staff and students had arranged a comprehensive programme and amongst the equipment shown running was the 2½-in. Mason extruder, the Latymer vacuum-forming machine and the Hupfeld 2-oz. injection machine.

Sir Eric Rideal calls for action. At a special meeting of the Plastics Institute's London Section on April 16, Professor Sir Eric Rideal gave his views on education and plastics. As one of Britain's most eminent scientists, as chairman of the Advisory Council of the D.S.I.R., and as founder of the department of colloid science at Cambridge, Sir Eric's views would have been worthy of a record audience; special accommodation had been taken at the Institution of Mechanical Engineers, and every member of the Plastics Institute had been circularized. A special invitation had been sent to leading members of the industry. And the summation of these efforts was an audience of some 60, indicative perhaps of the abiding interest of the individual in education.

Sir Eric's address was to the point. In his opinion, the present work at Cambridge, the Borough Polytechnic and anywhere else in Britain, was totally inadequate for the needs of the plastics industry. There were glaring deficiencies, resulting in the fact that we were not, as a nation, producing scientifically trained men suitable for the industry. Nor had we any centre for fundamental research of a co-ordinated kind.

He based his argument on the fact that much work, for example the kinetics of polymerization, were intellectual problems, immense in their scope, and this was why the university had restricted their work to problems of this kind, instead of venturing into wider fields.

He regarded these intellectual subjects as forming the first stage of development, in contrast to the work at Yale and elsewhere on polymer solutions, molecular weight distribution, vapour pressure, melting point, etc., which he regarded as forming the second stage of development. In this group, whilst much was being done at Aachen, Zurich, M.I.T., Cal. Tech., Brooklyn, and elsewhere, little or no work could be cited in Britain, outside commercial laboratories.

Stage 3 he envisaged as embracing such applied properties as creep, crazing, elastic and plastic properties, and this group, he said, was not provided for at university level in Britain at all.

He held that an ideal polymer course must embrace the three stages of development he had outlined.

He then posed the question—where should such a course be given—at university, at a technical college, or at a state institution, and drew attention to the varying viewpoints on this aspect. M.I.T., a most expensive and lavishly equipped unit, sponsored largely by and developed to a large extent to the needs of the oil industry, at one end of the scale, and the modest technical school at Zurich at the other end, based on organic chemistry since Switzerland has no heavy chemical engineering industries. Much thought would therefore have to be given to the precise form such a teaching centre should take, having regard to the nature of the chemical industry in this country.

On the ideal course of study he had the following suggestions:

(i) 3 years to honours degree standard.

(ii) 2 or 3 years for post-graduate degree. During phase (i), at least one year should be devoted to lectures on raw materials, polymerization, etc., and also experimental courses.

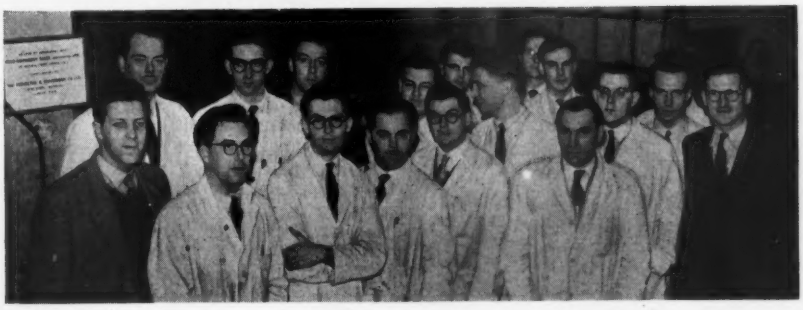
(iii) One year working in industry on a plant.

To point his moral, he said that we should not rely, as an industry, on techniques and processes bought from the U.S. and Germany, as we had done in the past, and as we might have to do in the future. Without properly trained men, and without working investigations along the three lines he had mentioned, we could not hope to remain in front.

There followed, under the chairmanship of Lord Halsbury, managing director of the National Research and Development Corporation, a most interesting discussion. Amongst the speakers were Dr. Ingall, Mr. Dring, Dr. Gordon, Dr. Child, Dr. Redfarn, Mr. Wentworth, Dr. Naracott and several others.

Both comments from the floor, and the replies of Sir Eric, underlined the recognition, if only by a minority, of the true gravity of the problem now confronting the industry. Either accept the challenge, or allow, by default, a gradual loss of power, in scientific, and technological, ability.

PLASTIKON.



Students at the Borough short course. Mr. Proctor and Dr. Pinner at far left and right.

Students handiwork at Borough.

The Properties and Testing of Plastics Materials—Part 3. (Cont.)

Sections 4—10. Thermal Conductivity, Expansion, Heat Resistance, Mould Shrinkage, Linear and Cubical Expansion, Thermal Conductivity, Shrinkage, Warping and Annealing.

By A. E. LEVER,* A.I.R.I., and J. RHYS,† M.Sc.

Section 4. Thermal Conductivity

AN interesting and simple method is described for determining the heat insulating properties of different materials (1).

Take a number of tin containers of equal size, make a hole in each to allow a test tube to just pass through. Fill the space round each tube with the material to be tested. Then fill the test tube with hot water and close it with a rubber bung, allowing for a thermometer to be inserted. Starting at the same temperature, note the rate at which it decreases due to heat loss to the surrounding material.

Heat conductivity is said to be in the unsteady state when the temperature at a point varies with time. The problem of calculating this temperature is discussed (2).

References

1. Building Science—Eng. Univ. Press, Ltd., 1944.
2. *Trans. I.R.I.*, 1954, **30**, No. 1, 16.

Section 5. Coefficient of Expansion

THE dilatometer methods described in (1) and (2) are typical of methods used for determination of linear and cubical thermal expansion.

Differential Thermal Expansion Apparatus (3) is used to measure the difference between rigid vinyls and steel.

Changes in dimensions due to changes of temperature are, in plastics, generally small, but they may be of importance where plastics and metals are used in precision instruments.

References

1. A.S.T.M. Spec. D.696-44, or U.S. F.S.S.C., L.P.406.
2. Ibid. D.864-52.
3. *Mod. Plast.*, 1954, **31**, No. 7, 120.

Section 6. Heat Resistance

THE effect of heat on the properties of materials is quite obviously of great importance, particularly when products have to withstand effects due to heat under a wide variety of service conditions. Such effects may be noticed in loss of electrical properties and so on.

The temperature range over which the physical properties of plastics are important is −100° to +450° C. when one considers both service conditions and processing temperatures.

An American Specification (1) defines the conditions for determining the permanent effect of heat on plastics. In this procedure, the material is first of all exposed in an air-circulating oven for four hours at a starting temperature near the maximum temperature at which the material would be expected to fail, and then by increments of 25° C. till failure is obtained. Failure is defined as a change in physical appearance, weight, length or other property in excess of the agreed limits.

After this temperature has been determined, another sample of the material is exposed in an oven at 30° C. below this temperature for seven days. Subsequently exposure temperatures shall be increased (or decreased) by 10° C. until failure occurs.

A very full report is given (2) on the heat resistance of phenolic laminated plastics. The results obtained indicated that flexural strength measurements, at elevated temperatures, would be of little value in indicating deterioration due to exposure to heat. Tests made at room temperature, after various periods of heat exposure, would be more useful. This method was used. Electrical properties showed an improvement on continued heat exposure. The size of the test piece had a marked effect on blistering temperature. There are numerous tables.

There is also (2) a good resumé of the temperature effect on various physical properties, with an adequate bibliography. See also (26).

Heat Distortion tests are used for determining the temperature at which an arbitrary deformation occurs under arbitrary test conditions (3). The specimen is mounted as a simple beam under a static load. The temperature is raised at a uniform rate, and the temperature at which the deflection is 0.010 in. is called the "heat distortion temperature." The method is suitable for control and development work. No fundamental quantity is measured.

For some non-crystalline materials, e.g., polymethyl methacrylate and polystyrene, the heat distortion temperature indicates the upper temperature at which a load may be supported (4). There are at least two separate properties involved in this test, i.e., loss of stiffness and creep. For design purposes, separate measurements of these properties are essential.

A hot deformation test for p.v.c. cables (5) consists essentially of heating a sample of the p.v.c. core; a load is applied and then the whole assembly heated for 24 hours at 70° C. The thickness of the deformed portion of the core is measured after cooling the assembly for one hour, and immediately after removing the load. Details of the apparatus are given, and there is a critical discussion (6).

A heat test consists of winding a sample of the core or sheath round a mandrel, heating for one hour at a prescribed temperature according to the grade of compound, and then examining for cracks.

A study has been made (7) to determine how the strains of moulding influence the rate of distortion of the test piece during heat resistance tests. A simple apparatus for measuring the deformation under load at elevated temperatures is described, with data on some of the results obtained. Compression and injection moulded test pieces were used.

The conditioning of polystyrene for many physical tests frequently results in partial annealing during the conditioning (8). This will raise the heat distortion temperature. The subject is investigated.

A specification (9) covers the procedure for determining the short-time stability at elevated temperatures of plastics containing chlorine. The results are expressed as milligrams of hydrogen chloride evolved per gram of a 10g test specimen.

A good qualitative test for p.v.c. is known as the **Congo Red** Test. A 10g sample of the material is cut into chips ¼ by ¼ by 0.060 in. and placed in a test tube over the lip of which a Congo Red test paper is placed. The tube is maintained at a temperature of 180° C. and the time taken for the indicator paper to show the presence of acid is a direct measure of the heat stability of the material. A material withstanding these conditions of 4-8 hours is generally satisfactory. Unstabilized materials will give a positive reaction in about 10 min. The use of chlorinated extenders will generally drop the stability.

The measurement of the effect of temperature on some physical properties of plastics is discussed (4), including tests at elevated temperatures.

Details of an apparatus used for the determination of the extensibility of p.v.c. sheet and film, after heat ageing, is given in a British Specification (10).

An American Specification (11) gives a method of test for determining the weight loss of plastics materials on heating when tested under definite conditions of exposure to heat and air. The Abderhalden oven is suggested.

Another apparatus (12) for determining the weight loss on heating a large number of specimens, consists essentially of a flow of clean, dry, pre-heated air. The equipment is inexpensive and easy to use.

All specimens for testing at high, or low, temperatures should be dried and then removed immediately to the testing temperature (13).

An investigation has been reported (14) into the dimensional stability of cellulose acetate under varying conditions of temperature and humidity.

* Consultant. † F. W. Berk & Co. Ltd.

ONE HUNDRED YEARS AGO

William Henry Perkin discovered the first synthetic dyestuff, mauveine, and so founded the modern dyestuffs industry. As the direct descendant of the firm Perkin and Son the Dyestuffs Division of I.C.I. is proud of its lineage, and of its technological contributions to the industry. Four of the six major dyestuffs discoveries of the past 35 years have been made in I.C.I. Laboratories.

ICI

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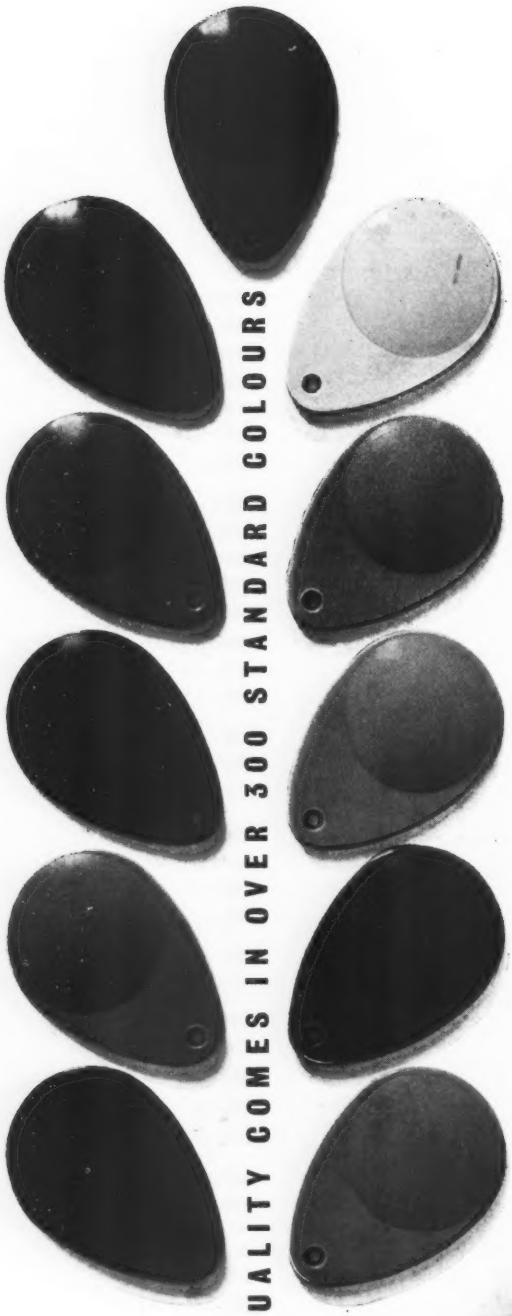

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The graph of the log of deflection, in mills, versus the log of the absolute temperature with regard to heat distortion data has led to some interesting observation (15). A marked difference between the behaviour of thermoplastic and cross-linked materials is shown, and the heat distortion test put on a somewhat sounder thermodynamic basis.

There is an interesting theoretical treatment of the thermal degradation of polymers during moulding (16).

The mechanism of the degradation of plastics by heat oxidation or ultra-violet light (outdoor exposure) is one where weak points are developed along the test piece exposed, and the concentration of these weak points increases with continuing exposure. The oxidation embrittlement of nylon is discussed (17).

A British Specification (18) covers the resistance to crushing of phenolic moulding materials after heating, and another for plasticized p.v.c. grommets (19). In the latter, specimens are exposed for six hours to a stream of hot air at 110° C., at a velocity of 18 in. per min.

A boiling water test for aminoplastic picnic ware (20) consists in immersing the moulded article in boiling water for 10 min. and then examining for cracks.

An apparatus is described (21) which measures the volume expansion over a wide temperature range. The transition temperature may be calculated from the slope of the expansion-temperature curves.

The Martin's method, used in Germany, for determining the deformation of plastics under heat is described (22) and data of some results are given.

Another test is given for machined or moulded specimens (23) in the form of a cylinder. The load, applied between two flat anvils, required to crush a specimen is measured (a) at room temperature before heating, and (b) after stoving at 130°-140°C. for 17 hours, stoving at 165°-170°C. for a further 6 hours and finally immersing in a bath of molten metal at 380°-410°C. for 30 minutes.

A test for the determination of the heat distortion temperature of cast polymethyl methacrylate material, in any square, rectangular or cylindrical form, is given (24), and for cast allyl plastics (25).

References

1. A.S.T.M. Spec. D.794-49.
2. Symp. on Plastics—A.S.T.M. 1944.
3. A.S.T.M Spec. D.648-45T.
4. Symp. on Plastics Testing—A.S.T.M. 1952.
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13. Elastomers and Plastomers—Elsivier Pub. Co., Inc., N.Y., 1948.
14. *Prod. Eng.*, 1945, **16**, 554.
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17. *Paint Man.*, 1950, **20**, 103.
18. B.S. 771-1938.
19. B.S. 1767-1951.
20. B.S. 1321-1946.
21. *Ind. Eng.*, 1942, **34**, 1053.
22. *Kunststoffe*, 1953, **43**, 214.
23. Testing of Plastics Part 2—Plastics Mono, No. 20A.
24. A.S.T.M. Spec. D.702-46.
25. A.S.T.M. Spec. D.819-50.
26. *Trans. P.I.*, 1954, **22**, No. 49, 205.

Section 7. Mould Shrinkage

AN American Specification (1) has been issued to measure the batch-to-batch uniformity of initial shrinkage, from mould to moulded dimensions. It does not provide for shrinkage due to ageing of the moulded material.

There are various factors affecting shrinkage:—

1. **Compression Moulding.** (a) Shrinkage will vary according to the design of the mould. (b) According to the operation of the mould. (c) The plasticity of the material in so far as it affects the retention and compression of the shape.

It is probable that minimum shrinkage will occur when a maximum of material is forced solidly into the mould cavity or where the article is hardened to a maximum value while still under pressure, particularly by cooling.

2. **Injection Moulding.** (a) Shrinkage varies according to the design of the machine. (b) According to the operation of the mould. (c) Type and size of the machine. (d) Thickness of moulded sections. (e) Temperature of mould. (f) Degree of flow of the material in the mould. (g) Size of sprue and nozzle. (h) Cycle of operating. (i) Length of time that follow-up pressure is maintained.

3. **Transfer Moulding.** (a) Design and operation of the mould. (b) Size of pot or cylinder and pressure on it. (c) Mould temperature and cycle.

An estimation of the amount of shrinkage is complicated by such factors as the size of the moulded pieces (2) which affects the temperature of its interior at any point in the moulding cycle. The recovery of the piece from deformations caused by the moulding pressure, and the orientation caused by the flow in the mould, will also have some effect. It has not been possible to predict accurately the behaviour of a material in one mould from observed behaviour in another.

Another American Specification (3) deals with determination of mould shrinkage for materials used for electrical insulations. Again a warning is given that shrinkage measured by this procedure may not be representative of shrinkages to be expected in other moulds or under other moulding conditions.

Decreasing the discharge temperature of the mould decreases shrinkage, and some plastics are very sensitive to this temperature.

This procedure is used (4) for determining shrinkage of various grades of phenolic moulding compounds, and data for the various types is given.

In a British Specification (5) a flash mould is used and shrinkage is calculated by subtracting the diameter of the cold moulding from that of the cold mould, and dividing by the diameter of the cold mould. A disc 4 in. by 5 in. dia. by 0.125 in. thick is used.

In another British Specification (6) shrinkage is measured also by determining the difference between cold moulding and cold mould, but by pre-conditioning for a specified period as follows: (a) Keeping in a desiccator over calcium chloride at 20° C., (b) Keeping in an oven at 38° C., with circulating air, or (c) In an oven at 100° C.

Roughly, the mould shrinkage increases as the ratio of the surface to the weight of the part increases. Of the factors controlling mould shrinkage, mould temperature is the most important (7).

References

1. A.S.T.M. Spec. D.955-51.
2. Elastomers and Plastomers—Elsivier Pub. Co., Inc., N.Y., 1948.
3. A.S.T.M. Spec. D.551-41.
4. A.S.T.M. Spec. D.700-52T.
5. B.S. 771-1938.
6. B.S. 1322-1946.
7. Mod. Plast. Ency., 1954, 93.

Section 8. Linear and Cubical Expansion

FOR determining the reversible linear thermal expansion, excluding changes due to moisture content, curing, degree of polymerization, loss of plasticizers, release of stresses, etc., a quartz tube Dilatometer is used (1). It is not applicable to very soft plastics.

Changes in linear dimensions of non-rigid thermoplastics sheet at elevated temperatures, is covered by specification (2).

An apparatus has been described (3) enabling linear expansion of small rubber test pieces to be studied over the range −65° C. to +20° C. It uses optical lever methods of measuring the linear expansion, and is capable of measuring movements as small as 10^{-5} in.

Cubical Expansion

A Specification (4) for determining the coefficient of cubical expansion covers rigid and non-rigid plastics.

The following results have been determined for the coefficient of expansion above and below the transition point (5):—

Cubic Expansion

Material	Coefficient of cubical expansion (per °C. × 10^6)		Transition point °C.
	Below	Above	
Polyvinyl acetate ..	232	694	24.9
Polyvinyl chloride ..	202	670	75.0
Polystyrene	211	589	78.0
Cellulose acetate ..	326	696	68.6
Cell. acetate butyrate ..	419	708	49.9
Cellulose nitrate ..	265	514	52.6
Polymethyl methacrylate	206	593	55.0
Polyvinyl chloride-acet.	171	590	48.2

References

1. A.S.T.M. Spec. D.696-44.
2. Ibid, D.1204-52T.
3. J. Appl. Phys., 1952, **3**, 373.
4. A.S.T.M. Spec. D.864-52.
5. *Ind. Eng.*, 1944, **36**, 279.

Section 9. Thermal Conductivity

AN apparatus for measuring the thermal conductivity of plastics materials is described (1). The conductivity can be increased at various percentages of packing granules to a solid mass.

There is also a useful account of various methods of measuring thermal conductivity, with a description of types of apparatus (2).

A method for determining the thermal conductivity of laminated plastics using the unsteady-state methods of the thermal diffusivity is described (3).

References

1. *Plastics* (*Lond.*), 1953, **18**, 255.
2. Ibid, 1944, **8**, 564.
3. A.S.T.M. Bull., 1951, No. 174, 54.

Section 10. Shrinkage, Annealing

FOR polystyrene a polarized light test was not of much value and the following tests were used (1):—

(a) **Kerosene Test.** This consists in immersing the article for one minute in kerosene, and then examining for cracking and crazing.

(b) **Thermal Shock Test.** In this method, the article is filled with hot water and replaced after one minute with cold water. The cycle is repeated at one minute intervals, and the article examined after 10 cycles. The cold water should be at 40-45°F., and the hot water at 190°F.

There is a discussion on the effects of various factors in the inception and growth of crazing (2).

Crazing is defined as visible mechanical cracks (3), or, submicroscopic failures that result in noticeable blushing of an otherwise transparent material (4), or, fine cracks which may extend in a network over or under the surface of or through a plastic (5).

The measurement of dimensional changes (principally shrinkage or elongation) from exposure to service conditions are detailed (6) (7).

Changes in dimensions may be caused by:—

(a) Deformation under load. (b) Swelling or shrinkage, by absorption, or loss, of moisture, etc. (c) Ageing. (d) Internal stresses. (e) Temperature changes.

A common way of examining moulded acrylic parts for the presence of frozen moulding stresses, is by inspection with polarized light (8) whereby the amount of stress in a part is indicated by the number of rings or fringes that become visible.

Each dark ring seen when viewing a part 1-in. thick through a polarized filter, when illuminated with polarized monochromatic light, will represent a stress of 1,000 p.s.i.

References

1. *Mod. Plast.*, 1946 (Oct.), **24**, 127.
2. *Plastics* (*Lond.*), 1954, **19**, 28.
3. Chem. Rept. No. 447, R.A.E., Aug., 1948.
4. *J. Appl. Phys.*, 1950, **21**, 1071.
5. A.S.T.M. Spec. D.675-45.
6. Ibid, D.1042-51.
7. Ibid, D.1181-51T.
8. Mod. Plast. Ency., 1954, 94.

Properties of Plastics, Heat Resistance, Thermal Conductivity, Flammability.

Typical data	Heat distortion temperature °F.	Safe operating temperature °F.	Specific heat cal./°C./cm.	Thermal conductivity cal./sec./cm.²/°C./cm. ×10⁻⁴	Coefficient of linear expansion In./in./°C. ×10⁻⁵	Flammability
Phenol formaldehyde Type G	275	300	0.4	4–7	3–7	Very low
Phenol formaldehyde Type MS	250	280	0.4	4–7	3–4	Very low
Phenol formaldehyde Type HS	250	240	0.4	4–7	4–7	Very low
Phenol formaldehyde Type HR	300	400	0.3	8–12	1.5–2.5	Very low
Phenol formaldehyde laminates—paper	320	250	0.3	2	1.5–3.0	Very low
Phenol formaldehyde laminates—fabric	320	250	0.3	2	2.0–3.0	Very low
Cast phenolics	240	160	0.3–0.4	4	3.0	Very low
Urea formaldehyde—paper filled	200	175	0.4	7–10	2.7	Very low
Urea formaldehyde—wood filled	200	175	0.4	7–10	2.8	Very low
Urea formaldehyde laminates—paper	—	200	0.3	2	2.5	Very low
Urea formaldehyde laminates—fabric	—	200	0.3	2	2.5	Very low
Melamine formaldehyde	300	250	0.4	7–10	4	Nil
Melamine formaldehyde laminates—paper	—	200	0.3	2	2.5	Very low
Melamine formaldehyde laminates—fabric	—	200	0.3	2	2.5	Very low
Polyesters—unfilled	240	—	0.25	—	3.5	Low
Polyester glass laminate—rovings	—	300–350	0.25	8–10	ca 1.0	Low to self-extinguishing depending on resin
Polyester glass laminate—cloth	ca 300	300–350	0.25	8–10	ca 1.0	
Polyester glass laminate—mat.	ca 250	300–350	0.25	8–10	ca 1.0	
Cellulose nitrate	150	140	0.4	5	12	Very high
Cellulose acetate	120	160	0.3	7	15	Low
Cellulose acetate—butyrate	140	170	0.35	6	16	Slow burning
Ethyl cellulose	130	180	0.4	5	12	Slow burning
Polyethylene	100	210	0.55	8	14	Slow burning
Polytetrafluorethylene	270	500	0.2	6	10	Nil
Polyvinyl chloride (P.V.C.)—rigid	140	130	0.25	4	5	Self-extinguishing
Polyvinyl chloride (P.V.C.)—plasticized	—	130	—	3–4	—	Slow
Polyvinyl chloride-acetate—rigid	140	130	0.2	4	8	Self-extinguishing
Polyvinyl chloride-acetate—plasticized	—	130	—	3–4	—	Slow
Polyvinylidene chloride	150	180	0.3	3	19	Self-extinguishing
Polystyrene	170	165	0.35	2	7	Slow
Polystyrene (and alloys)—high impact	160	140	0.35	2	4–20	Slow
Polymethylmethacrylate	160	140	0.35	5	9	Slow
Nylon moulding powder	300	300	0.4	6	10	Self-extinguishing
Nylon filaments	—	—	—	—	—	Self-extinguishing
Silicones (elastomeric)	—	300–500	—	—	—	Self-extinguishing
Natural rubber	—	—	—	—	—	Medium
Hard rubber	240	140	0.4	3	7	Medium
Shellac	—	275	0.4	3	—	Low
Casein	300	150	—	—	5	Low

Plastic Film Developments for Horticulture

BRITISH VISQUEEN, LTD., a subsidiary of Imperial Chemical Industries, Ltd., are introducing two new developments in the use of plastic film in horticulture. The first is Thermoplus 50—a heavier gauge of Thermoplus which has recently had a remarkable success as an inner lining for the insulation of glasshouses. Thermoplus 50 is designed for outside work in the construction of cloches, covering of frames, etc., and has the high light-transmission characteristics of Thermoplus.

The second development is black Visqueen film, which has been used successfully in the United States with crops such as strawberries. The film is unrolled over the row of plants and slit with a knife above each plant. It is then eased down over the foliage, which holds it in place, and if necessary earth is forked over the edge of the film to prevent lifting by the wind. The film is perforated to allow penetration by rainwater and is black in colour to prevent, as far as possible, the growth of weeds. Further particulars are available from British Visqueen, Ltd., Stevenage, Herts.

PATENT REVIEW

The following abstracts have been made from specifications at the Patent Office, with the permission of the controller of H.M. Stationery Office. The country of origin for Convention Applications is shown in parentheses. Complete specifications can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 3s. 0d. each (including postage).

B.P. 742,710. Plastic film product and process for making same. To: Paper Patents Co. (U.S.A.).

Polyethylene, polyvinyl chloride, alcohol, acetate films when used for packaging, box liners, etc., are made as thin as possible (less than 5 mils) for economic reasons. To give body to such films, make them gas-proof and adherent to paper, a thin and loose fibre web is embedded in the film.

B.P. 742,723. Binding material. A. C. Radtke. To: International Harvester Co.

For tying bales parallel and untwisted glass filaments in groups are enclosed in a thermoplastic covering forming a continuous ribbon. Polystyrene, vinyl resins, methyl methacrylate, nylon plastics, cellulose derivatives are mentioned.

B.P. 742,752. Surface colour and relief effects of thermoplastic artificial materials and process for their manufacture. H. Burgtore, E. Schwartz, J. H. Benecke (Germany).

Coatings, sheets are applied to a carrier surface, dyed to the colour of a genuine textile, printed with a colour pattern, then embossed to reproduce the surface texture and relief effect of textile, knitted material, plaited work. For curtaining, wallets, upholstery, bags.

B.P. 742,760. Methods for the production of an insulating layer of foam plastics on an electrical conductor. To: Telefonaktiebolaget L. M. Ericson (Sweden).

The plastic material is fed by an extrusion screw while a gas is mixed into the plastic at such a pressure as to dissolve in the required quantity for foam making. The obtained homogeneous solution is brought on to the conductor in an even layer after passing through pressure-reducing units. Cooling is effected by the evaporating gas.

B.P. 742,786. Phenol formaldehyde moulding powder and method of making the same. C. H. Hempel. To: Heresite and Chemical Co.

Phenol formaldehyde resin prepared in aqueous solution is, after removal of water, violently agitated at approximately 95 deg. C. The product passes through a syrupy phase into a soft lumpy phase, ultimately into a dry powder. The moulded products are transparent, of great chemical and water resistance, have high dielectric properties.

B.P. 742,787. Laminated insole. To: Scholl Manufacturing Co. Ltd. (U.S.A.).

An intermediate heat-reflecting lamination of moisture-proof material, e.g. metallic foil, but also of other rigid material as polyvinylidene chloride.

B.P. 742,798. Collapsible tubes. G. W. Ayres. To: Venesta Ltd.

With a slitted nozzle of rubber, polyvinyl chloride, polythene fitting over the neck, which has a flanged shoulder under a closure cap.

B.P. 742,801. Sealing conductors through bulkheads. W. K. Weston, G. W. Clarke, R. J. M. Andrews. To: Standard Telephones and Cables Ltd.

To prevent extrusion of plastic (polythene) insulant through bulkheads into a housing containing amplifying repeaters in a submarine cable due to great pressure differences outside and inside the housing, use is made of an insulating bush of quartz, ceramic or vitreous material having a coating of soft metal. The outside pressure drives the conductor rod into a bore in the bush of less diameter than the conductor, the polythene insulated portion remaining outside in a special joint.

B.P. 742,803. Foamed synthetic resins. To: Spumalit-Anstalt (Switzerland).

A pre-foamed mass of resin is extruded through one or more orifices, reduced to granules of the desired grain size, and heated until hard to produce cellular granules for building or insulating purposes.

B.P. 742,810. Manufacture of highly polymeric polymethylene terephthalates. N. Fletcher. To: Imperial Chemical Industries, Ltd.

B.P. 742,811. Manufacture of highly polymeric polymethylene terephthalates. N. Fletcher, R. L. Heath. To: Imperial Chemical Industries, Ltd.

B.P. 742,830. Submarine cable repeater housings. W. K. Weston, G. W. Clarke, R. J. M. Andrews. To: Standard Telephones and Cables, Ltd.

B.P. 742,840. A new improved blind. E. Willets, E. G. Willets.

A blind for windows vertical or horizontal or in any other plane. The curved slats may be of plastic or aluminium or like material.

B.P. 742,861. Advertising display or like signs. J. G. Cosgrove, E. F. Humphreys.

An embossed (letters, pictures) plastics sheet has a polished surface so as to adhere to glass under pressure without using adhesive.

B.P. 742,901. Manufacture of plastics ampoules. To: Sterling Drug Inc. (U.S.A.).

Made from plastics tubing. Cutters slit the tube outside the sterilizing housing.

B.P. 742,907. Copolymers of trifluorochloroethylene and vinylidene fluoride and method for their preparation. To: M. W. Kellogg Co. (U.S.A.).

Used as protective coatings of high tensile strength, heat resistance and hardness.

B.P. 742,908. Copolymers of trifluorochloroethylene and vinylidene fluoride and method for their preparation. To: M. W. Kellogg Co. (U.S.A.).

Particularly useful as durable, flexible coatings for application to fabric surfaces (protective clothing).

B.P. 742,933. Polymeric substances. A. Charlesby. To: United Kingdom Atomic Energy Authority.

Polythene has incorporated therein carbon black and is then subjected to ionizing radiation. A substance of increased mechanical strength is obtained.

B.P. 742,937. Educational device for demonstrating geographical contours. T. J. Jones.

A moulding of transparent thermoplastic material shaped to resemble a geographical surface integrally moulded with a flat flange connected to the model by a step.

B.P. 742,969. Baby's inflatable, portable bath convertible to travelling bag. J. E. Wójcik.

By deflating, folding in ends, and pulling top together.

B.P. 742,981. Improvements relating to shoes. R. J. Marcy. A shoe counter is moulded from polyethylene of such thickness that when released after deformation it will return to original shape.

B.P. 742,988. Holding arrangements for knitting wool and the like. F. H. Green.

A rotatable spring device on plastics bracelet.

B.P. 743,001. Plugs for water sinks and the like. T. F. Morton, L. A. Steer.

A resilient annulus is clamped between metal plates to be expanded by pressure (screwing) to exact fit.

B.P. 743,005. Electrical heating unit for use in uniting thermoplastic paper to surfaces. J. A. Luff. To: A. Adkins and Sons, Ltd.

The paper is applied to box panels in box-making machines by a heated rocking shoe floatingly suspended to "iron" the passing work.

B.P. 743,014. Enteric capsules for medicaments. G. D. Hiatt, C. J. Malny. To: Kodak Ltd. (U.S.A.).

Cellulose derivatives containing ethoxyl and phthalyl groups can be employed for enteric capsule shells.

B.P. 743,025. Process and apparatus for the manufacture of moulded articles mainly for optical uses. L. Le Marrec (Morocco).

The edge of the lens is subjected to pressure to permit a contraction on the diameter only, which automatically counteracts shrinkage in other directions during polymerisation. Thus the optical constants are maintained.

B.P. 743,032. Electrically heated textile appliances. V. E. Swindells, J. E. Blackburn. To: Thermega Ltd.

The heating element of an electrically heated blanket is encased in a polythene sheath. The conductor extending along the exterior of the sheath has an outer cover of polyvinyl chloride. Overheating causes melting of the sheath and produces a short circuit through a fuse to interrupt the current.

B.P. 743,059. Former cups for use in pavement or roof lights. F. C. Howarth.

Plastic formers are used remaining in position after being housed in the reinforced concrete or cement.

B.P. 743,064. Production of thermoplastic powders. D. Finlayson, B. Krzesinski, A. Harcolinoski. To: British Celanese Ltd.

Uniformly coloured cellulose acetate (ester, ether) powder is produced by heat treatment at between 190 and 210 deg. C.

B.P. 743,114. Manufacture of profiled sheets of non-uniform thickness from fibre-filled plastic material. P. Harder.

After being pressed into the desired shape the mixture is heated when still under pressure by high frequency current. A moulding board is inserted between the plane parallel electrodes and the profiled surfaces.

B.P. 743,124. Manufacture of separators for electric accumulator plates from sheet material in ribbon form. J. Dowse. To: British Fibrak Separator Co. Ltd.

The material (paper pulp impregnated with resin) is progressively deformed about parallel fins from the middle outwardly towards each edge. Heat and pressure are applied selectively to cure only the resin in and near the deformed areas. The crests of the lengthwise formed ribs are then coated with a 70% resin solution and the uncured resin cured.

B.P. 743,125. Device for carrying receptacles. C. C. J. Riesebeck. (Germany.)

A main handle in the form of a yoke and a secondary handle member to be interlocked with it and an attachment for connection to the handbag or shopping bag or net.

B.P. 743,215. Container for electric storage batteries. P. J. Moll. (Germany.)

The container is composed of structurally independent rectangular cells injection moulded from a synthetic resin. Each of the oppositely facing walls of adjacent cells is provided with at least one integrally moulded rib, the ribs to be connected together so that the cells form a structural unit.

B.P. 743,218. Weather screen for motor cycles and like vehicles. W. J. Bush.

Main and extension arcuate members of transparent plastics. The main screen member is attached to the vehicle, the extension members slide in a concentric path around the main screen. The effective overall height and the rearward curvature are adjustable.

B.P. 743,229. Manufacture of regenerated Cellulose films. W. Berry, H. J. Ward, B. V. Fox, G. D. Pearce. To: British Cellophane, Ltd.

Adhesion between the smooth surfaces hinders the separation of the films in use (wrapping). By applying a mixture of water-soluble and water-insoluble soap and then drying the film, surface-tackiness is eliminated.

B.P. 743,230. Method of making a cuprammonium cellulose solution. E. J. Courtney. To: Cellulose Fibers Inc.

An agitator is rotated in the mixture at such a speed as to produce a zone of violent agitation. A fibre-free solution may be obtained in 2 to 20 minutes.

B.P. 743,231 Anti-glare device. M. H. Thornton.

To be mounted on the head or the spectacles of a motorist. Segmental semi-transparent lens parts are mounted over the glasses or on a holder to shield the wearer from the glare of oncoming vehicles while leaving him a clear vision along the lane he is travelling. The dividing line is made sharp by a straight edge to be adjusted into correct relation over the lens.

B.P. 743,242. Sealing of containers. J. N. Read.

The joints of a (food) container are sealed by a coating of epoxy-ethane derivative resin and subsequent seaming.

B.P. 743,261. Apparatus for evacuating bags. J. T. Wade and Son, Ltd., S. C. Wade, C. H. Copeman.

For evacuating polyethylene bags containing perishable goods to be stored in "deep-freeze" chambers where air left in the bag will cause fat to go rancid.

B.P. 743,281. Production of composite polyethylene terephthalate. To: E. I. Du Pont de Nemours and Co. (U.S.A.).

The film has an adherent metallic coating on one or both surfaces. The coating is preferably 0.0004 to 0.0008 mil thick. It has improved water vapour and organic vapour resistance, reflects radiant heat, has an electrically conductive surface, may be used for unusual decorative effects.

B.P. 743,305. Process for the manufacture of thermoplastic masses. B. E. Smith, W. E. A. Simon.

Wood is subjected to two treatments, a reflux condensation to effect polymerization of lignin and an etherification with benzyl chloride.

B.P. 743,312. Silicone resins. To: Midland Silicones, Ltd. (U.S.A.).

Elimination of bubbling during cure by adding carboxylic acids.

B.P. 743,364. Method of producing porous bodies of thermoplastic material. To: Isoleringsaktiebolaget WMB (Sweden).

The material is fed continuously to a nozzle by a double screw pump where it is subjected to heat and pressure. To the gelatinized material obtained solvent is applied at high pressure to cause the mixture to expand when ejected through the nozzle which ensures the desired porosity.

B.P. 743,382. Printing plate. O. L. Boll, J. J. Barvir, C. K. Head. To: Plastotype, Ltd.

The flexible plastics printing plate and electro mould consist of a layer of plastics material and a reinforced backing of a resin impregnated perforated layer of fabric.

B.P. 743,390. Solid polyethylene and the production thereof. To: Olin Mathieson Chemical Corp. (U.S.A.). Ethylene is polymerized in a non-aqueous system at 20,000 to 30,000 psig, at 110 to 225 deg. C., in the presence of a solvent.

B.P. 743,399. Cigarette and like holder. W. G. R. Sleeman. Combined holder and ash collector.

B.P. 743,401. Production of articles by moulding substances of vegetable origin under pressure and at elevated temperatures. R. Runkel, J. Jost. (Germany.)

Shavings, sawdust, turnings are first subjected to heat and pressure to produce water vapour and volatile reaction products, then the material is reacted in the mould with the reaction products of the first stage. Synthetic resins may be added and fillers and the reacted material discharged through a moulding orifice to obtain an extrusion moulded article.

B.P. 743,423. Calendars. E. Weber. (Switzerland.)

Refers to a day indicator to be pressed into contact with the calendar sheet.

B.P. 743,440. Masked printing means. M. A. Harper, T. E. H. Gray, J. J. Hinton. To: Dunlop Rubber Co., Ltd.

For producing patterns or pictures containing fine details on rubber or polyvinyl compound surfaces. A pigmented plastic composition has shaped pieces of material (thin metal) embedded in its surface insoluble in a solvent for the plastic composition. The printing layer of this composition is applied to the surface to be printed moist with a solvent for the composition.

B.P. 743,452. Method and apparatus for curing friction compositions. To: Raybestos Co. (U.S.A.)

Curing of friction material (brake linings) containing heat-hardenable binder.

B.P. 743,464. Composition for, and method of, applying coatings of polychlorotrifluoroethylene. M. H. Nickerson (U.S.A.).

A dispersion of finely divided polychlorotrifluoroethylene in a chlorinated diphenyl is applied in one operation as a coating with a final fused thickness of up to 0.005 in.

B.P. 743,467. Apparatus for the production of articles under pressure and at elevated temperatures. R. Runkel, J. Jost. (Germany.)

Refers to a gas-tight joint obtained through the arrangement of two grooves around the pressure mould (div. out of 743,401).

B.P. 743,494. Polyester resin. A. D. Cunningham. To: British-Thomson-Houston Co., Ltd.

An acidic or basic inhibitor is added to prevent polymerization during storage.

B.P. 743,497. Insulating material for electrical apparatus. To: E. I. Du Pont de Nemours and Co. (U.S.A.).

A biaxially orientated polyethylene terephthalate film which has been stretched in longitudinal and transverse directions and is then heat set.

B.P. 743,503. Polyethylene terephthalate film having improved physical properties. To: E. I. Du Pont de Nemours and Co. (U.S.A.).

The film is sequentially stretched at a rate of at least 400% per minute in longitudinal and transverse directions, then heat set.

B.P. 743,587. Resinous nitrile reaction products and their method of preparation. D. W. Sear. To: Dunlop Rubber Co., Ltd.

For the production of adhesives. A reaction product of a polyhydric phenol, a lower aliphatic ketone and a polymer or copolymer containing nitrile groups.

B.P. 743,591. Fasteners. L. Parkin. To: Carr Fastener Co., Ltd.

E.g. for securing carpets to apertured floor panels of motor cars. The tubular closed socket part may be formed from a plastics material such as polythene preventing the ingress of moisture or entry of air.

B.P. 743,594. Adhesive tape. J. Lohmann, G. A. Barth, K. Lohmann (Firma Lohmann K.G.) (Germany).

Particles of fine-grained substances (metal oxides, mica, silica gel) are fixed to a backing of synthetic resin, regenerated cellulose, cellulose derivative film to increase the adherence of the adhesive coating on the roughened film surface.

B.P. 743,605. Method of producing silage. To: N.V. Maatschappij tot Exploiteren van Octrooien en Licenties "Matepa" (Netherlands).

Overlapping strips of synthetic resin material are used for an inner and an outer covering with oxygen converting material (earth, manure, etc.) between to prevent condensation over the internal surface of the inner covering with the danger of rotting the silage.

B.P. 743,682. Domestic ice trays. G. Chausson. To: Soc. Anon. des Usines Chausson.

Particle size, varying powers of refraction, physical form — these are all important factors determining the suitability of a pearling agent for any particular application. The **M&B** *products form a range of economical and effective pearling agents for most requirements.*

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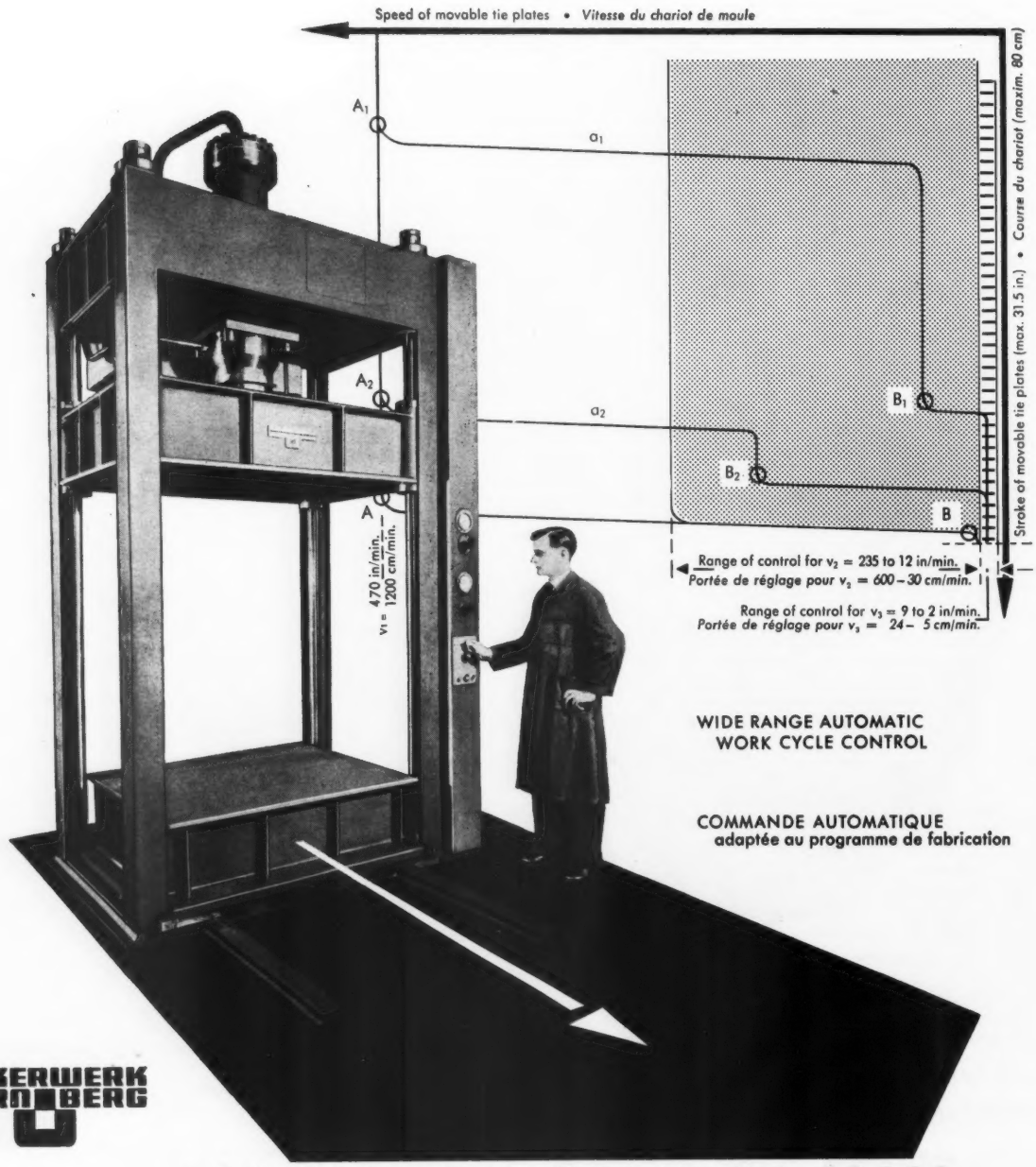
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A1
a1
A2
a2
A
v1 = 470 in/min. 1200 cm/min.
B1
B2
B
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Portée de réglage pour v2 = 600 – 30 cm/min.
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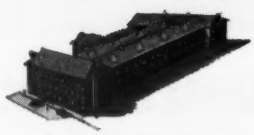

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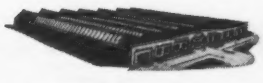

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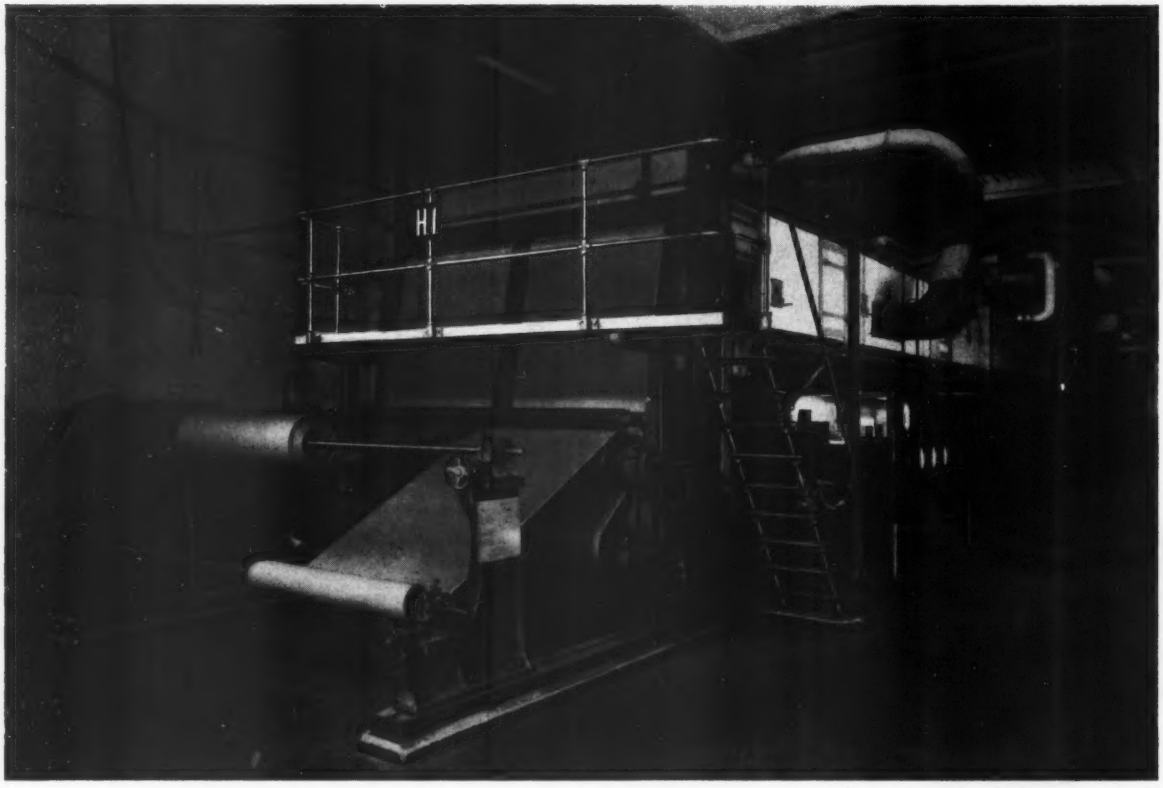

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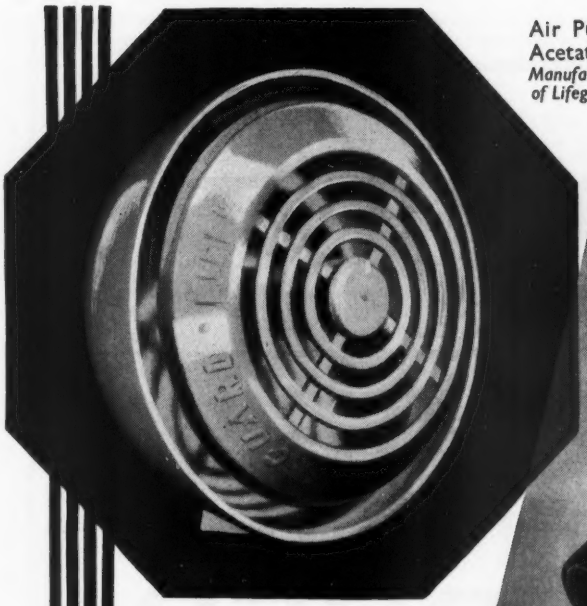

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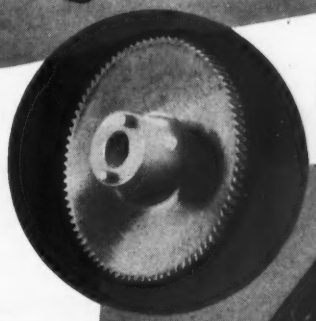

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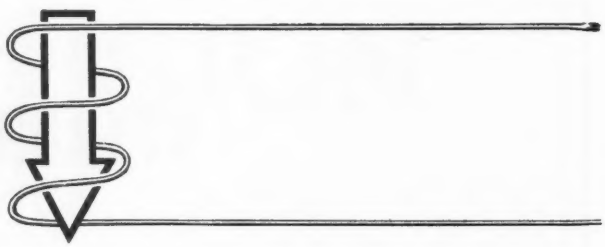

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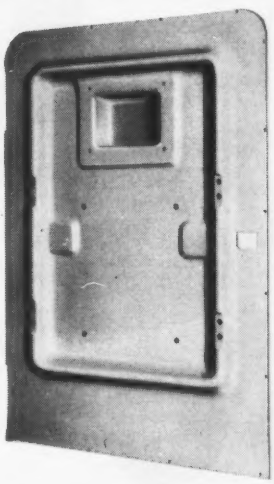

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With the exception of the door liner, the Ekco mouldings for the LEC refrigerator are injection moulded in medium-impact polystyrene. The door liner, with integral butter compartment, is vacuum formed from sheet polystyrene on a cast non-ferrous tool.

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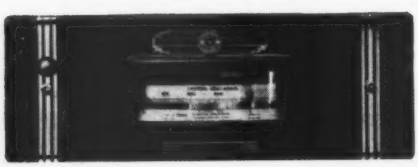

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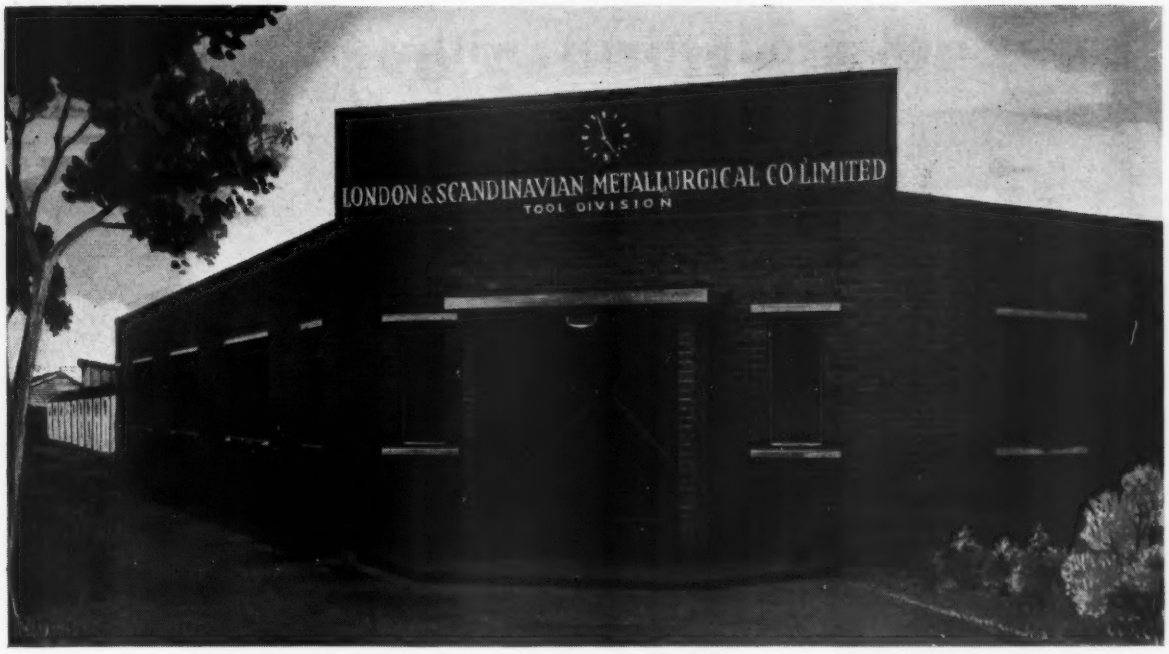

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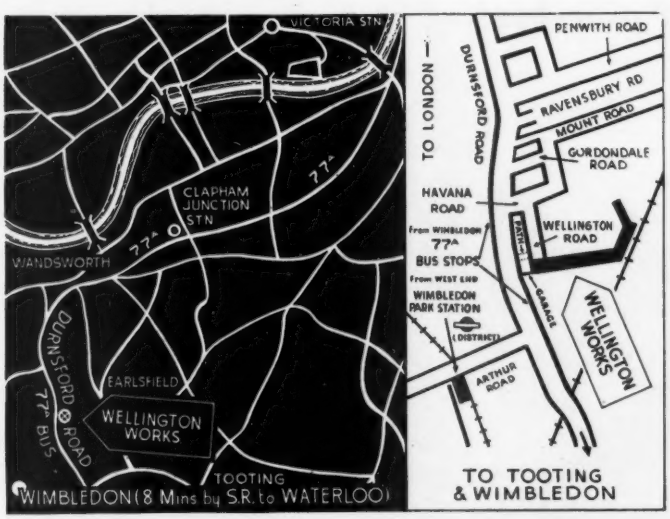

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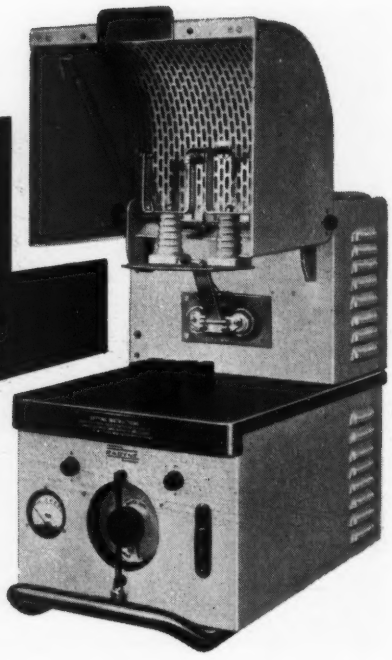

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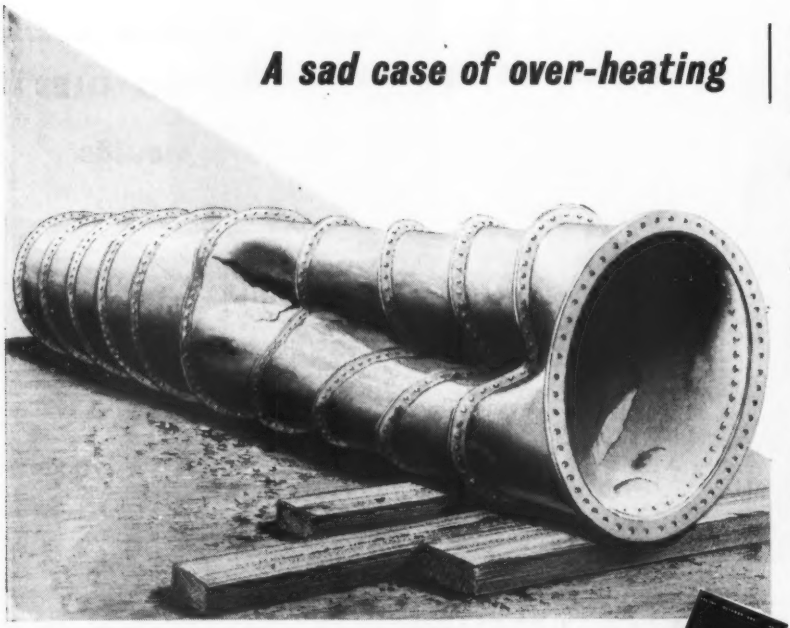

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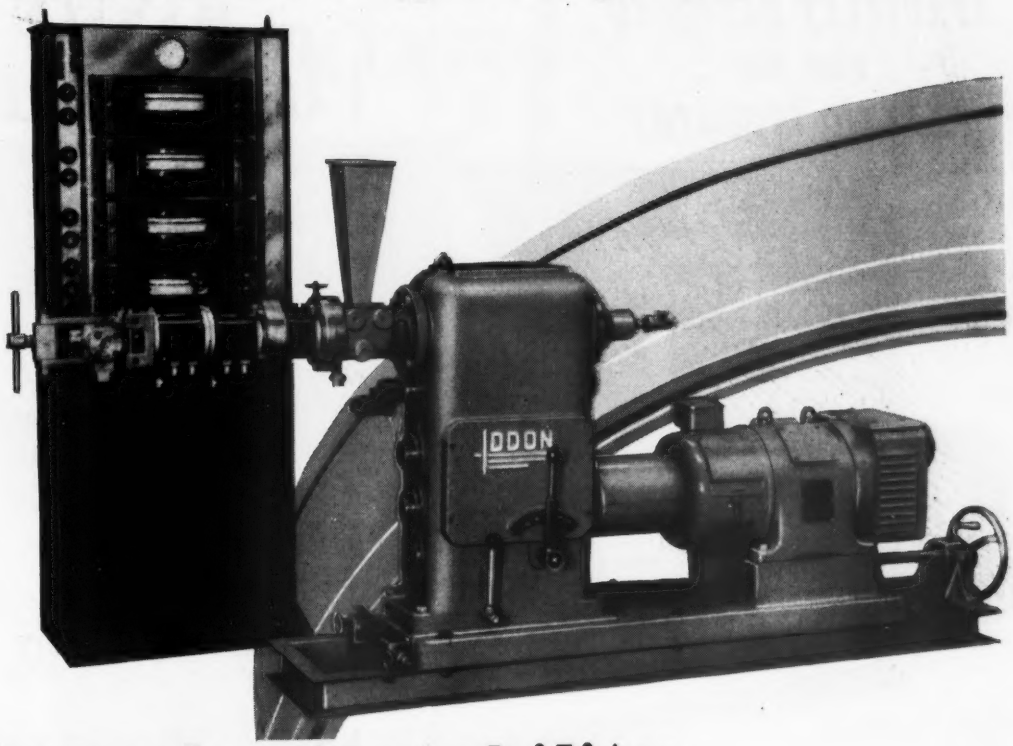

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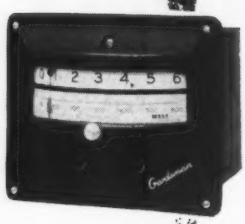

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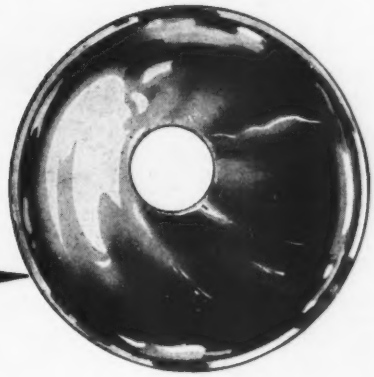

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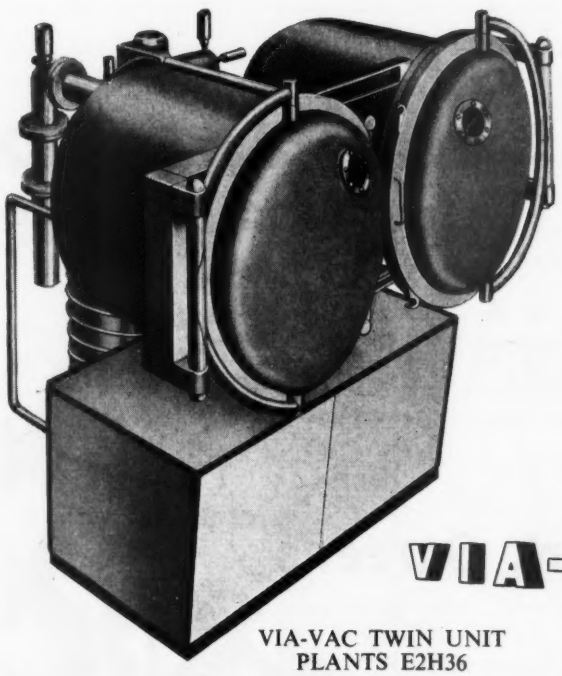

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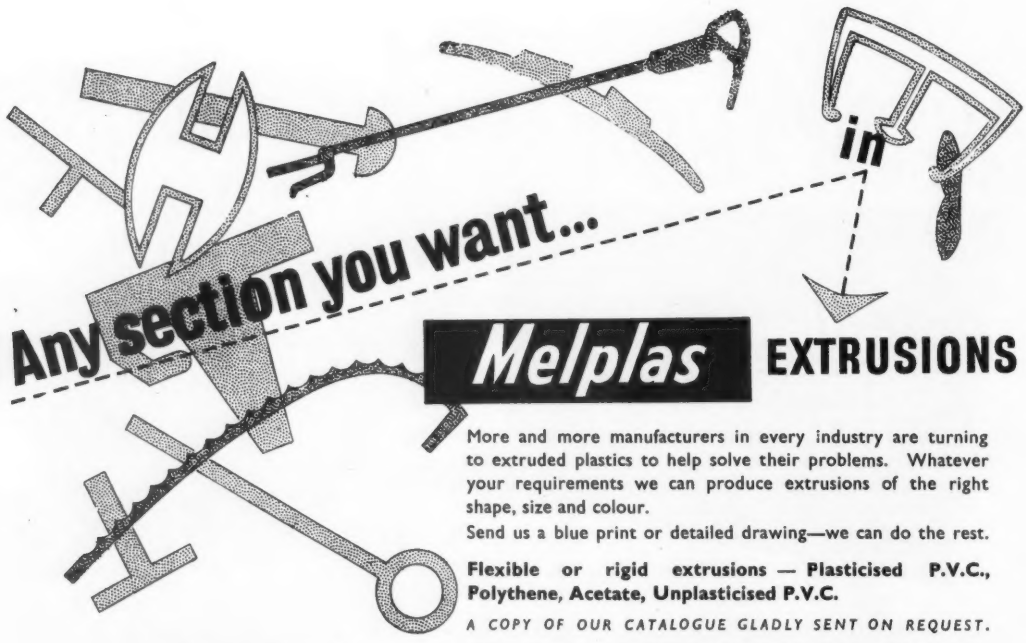

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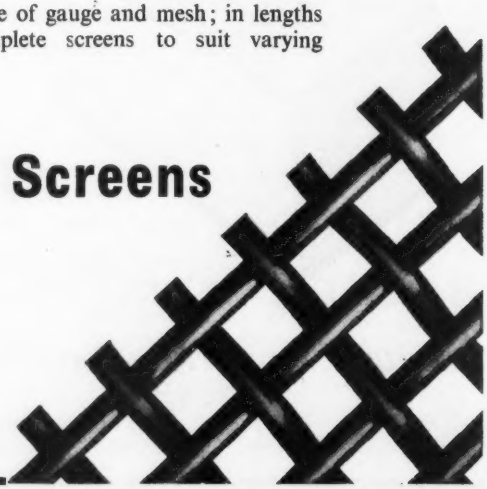

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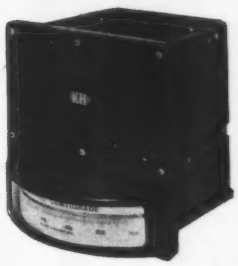

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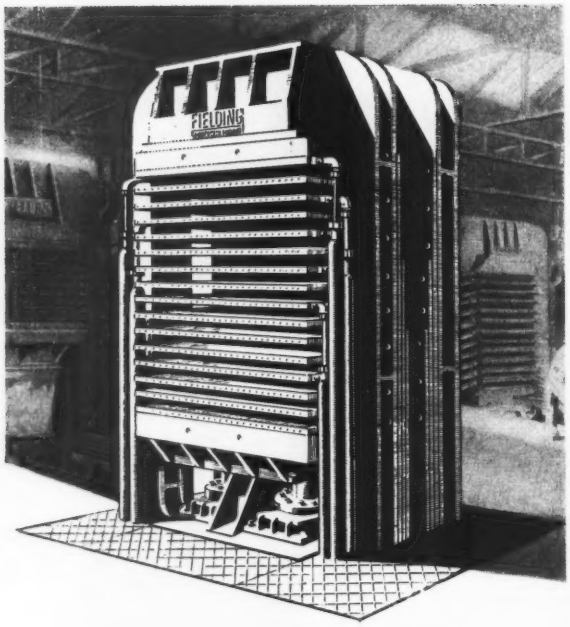

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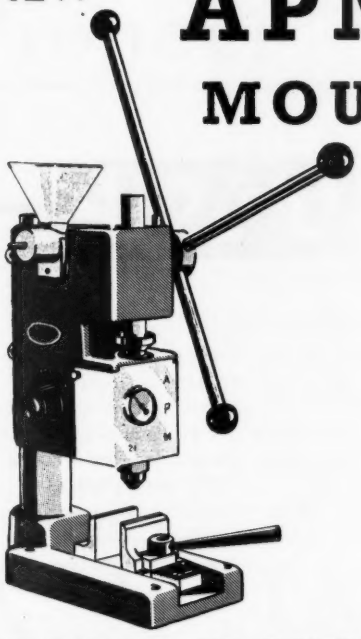

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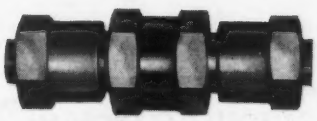

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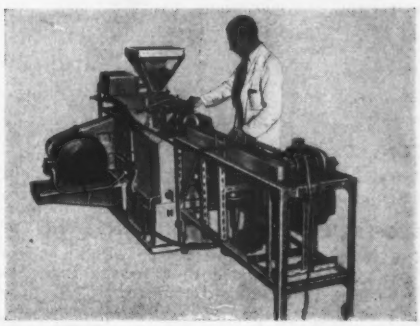

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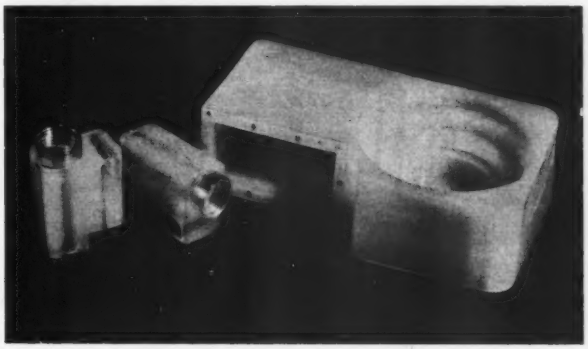

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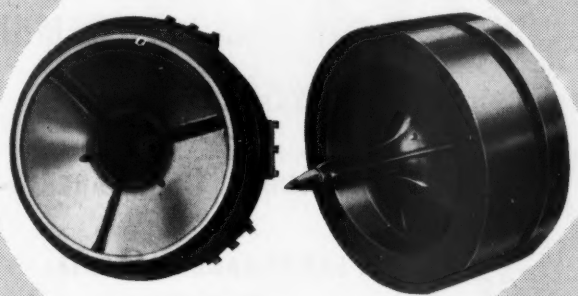

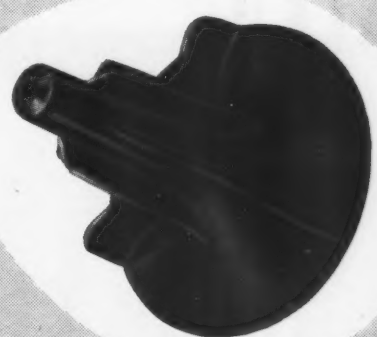

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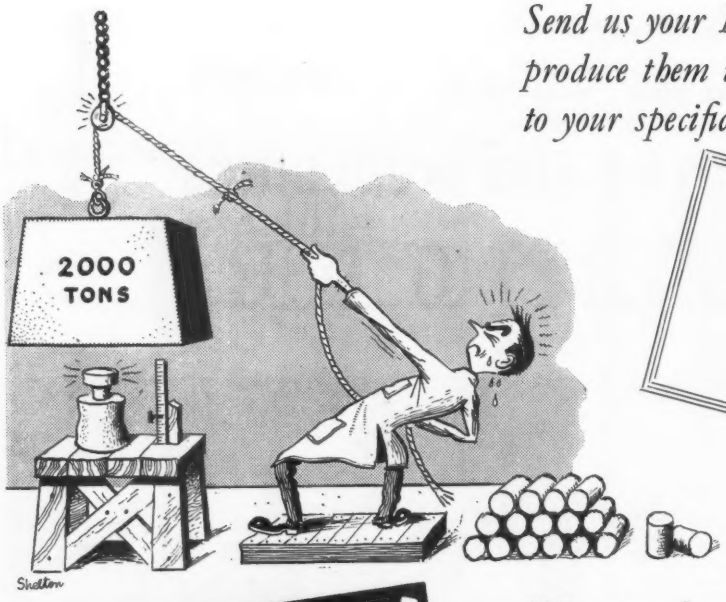

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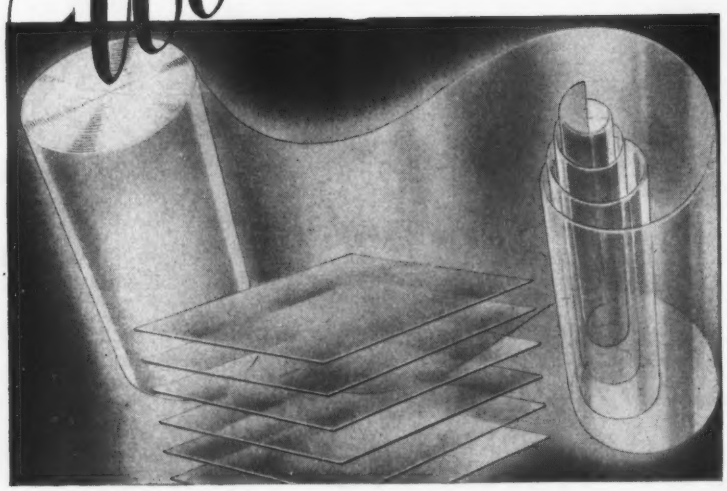

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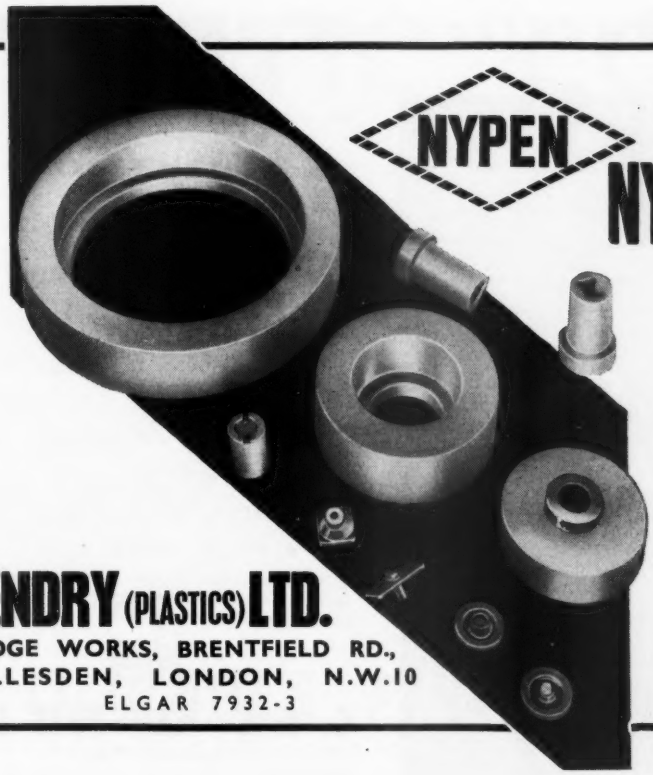

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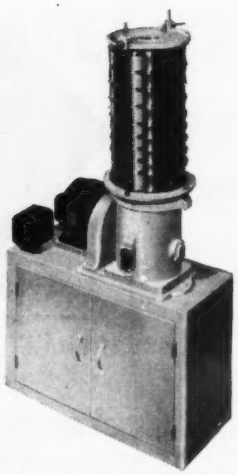

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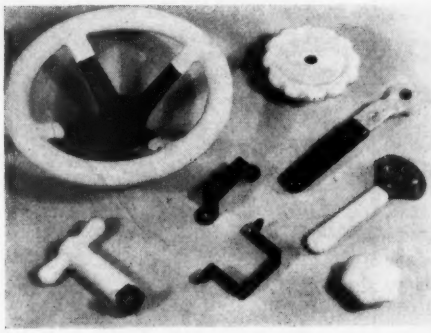

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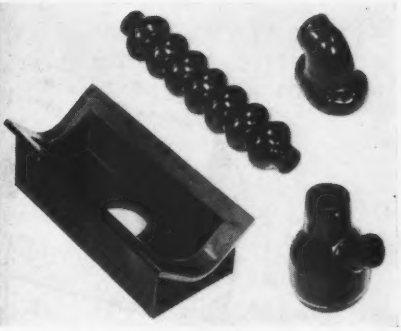

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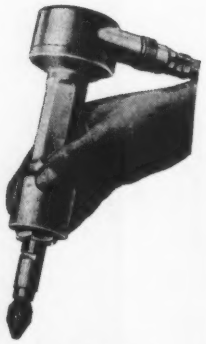

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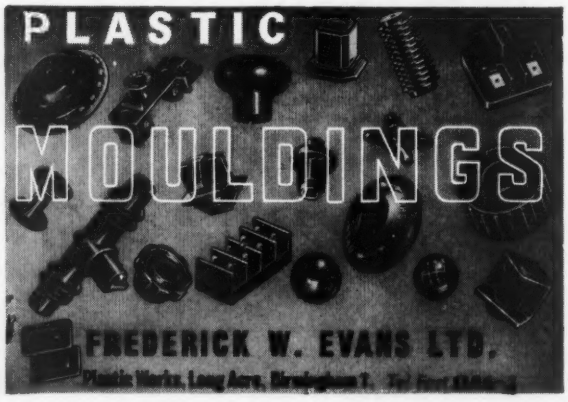

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POLYSTYRENE REPROCESSED, jet black at 1s. 10d. per lb., light colours at 1s. 10d. per lb., medium colours at 1s. 7d. per lb. Herbert Connor, Ltd., 120 Beaufort Park, Falloden Way, London, N.W.11. 224-62

POLYSTYRENE, PEARL, turquoise, 2,000 lb. surplus to requirements for disposal. Inquire Box P2436, care of "Plastics." 224-64

POLYTHENE FILM SCRAP, perfectly clean, several tons for sale. Please write Box P2442, care of "Plastics." 224-66

NYLON, reground and lumps, various colours for sale. Box P2445, care of "Plastics." 224-67

RAW MATERIAL WANTED

PROMPT CASH OFFERED for virgin and reprocessed cellulose acetate and polystyrene. Give manufacturer's name and backing. Box P873, care of "Plastics." zzz-306

P.V.C. GARMENT AND HANDBAG OFFCUTS wanted. We collect and pay cash. Brockwell Plastics, Ltd., 50 Hollingbourne Rd., S.E.24. zzz-305

WANTED, Polythene scrap. Write to Box P221, care of "Plastics." zzz-0322

WANTED, large regular supplies of nylon scrap shaving. Hugh Kershaw, Oxenhope, Keighley. 226-1183

ERLANOS, LTD., 93 Aldersgate St., E.C. (Monarch 4686), require Perspex and cellulose offcuts and scrap, clear and coloured; highest prices paid. 229-1159

DO YOU HAVE ANY PLASTIC SCRAP TO SELL? Or are you looking for some to buy? Then contact Michael St. Stevens, Ltd., Keswick Rd., S.W.15. Phone, Vandyke 3345-6. zzz-0303

SURPLUS STOCKS of thermosetting and thermoplastic moulding powders wanted. Send details. Box P1727, care of "Plastics." zzz-297

WANTED, plastic scrap. Send samples, details, price, etc., Box P2448, care of "Plastics." 224-70

DIAKON ACRYLIC SCRAP. We buy large and small quantities and pay prompt cash. Send your offers immediately to J. W. Nash and Co., Ltd., 27 Beethoven St., W.10. 224-50

URGENTLY REQUIRED, minimum 10 tons medium hardness green p.v.c. compound, varying shades of green accepted and if in good condition scrap material will be considered. Box P2447, care of "Plastics." 224-69

POLYTHENE, NATURAL, in any form and quantities required. Please offer with particulars to Herbert Connor, Ltd., 120 Beaufort Park, London, N.W.11. 224-65

REPRESENTATION

DUTCH IMPORTER wishes to represent manufacturers of all types of plastic materials in Holland. Apply Box P2415, care of "Plastics." 224-12

IMPORTERS AND DISTRIBUTORS wanted to represent manufacturers of P.V.C. plastic sheetings and upholstery leathercloths. Please write to Mee Tak Company, 29 Jervois St., Hongkong. 224-48

SITUATIONS VACANT

The engagement of persons answering advertisements in respect of vacant situations must be made through a local office of the Ministry of Labour, or a scheduled employment agency, if the applicant is a man between the ages of 18 and 64 inclusive, or a woman between the ages of 18 and 59 inclusive, unless he or she, or the employment, is excepted from the provisions of the Notification of Vacancies Order, 1952.

SETTER CHARGEHANDS required by company engaged in injection moulding, experienced operators wishing to progress will be considered, good rates of pay and bonus, canteen and social club facilities. Please apply Injection Moulders, Ltd., Westmoreland Rd., Queensbury, N.W.9. Col 8868. 224-x3866

OLD-ESTABLISHED COMPANY which two years ago developed a plastics division for the processing of specialized plastics requires fully qualified chemist or chemical engineer; the selected candidate must be capable of original thinking and have the initiative to solve novel problems, first-class prospects of promotion as the division expands. Write 1049, Wm. Porteous and Co., Glasgow. 224-40

A VACANCY HAS ARISEN in the Plastics Laboratory of a research and development-minded, progressive company in the South London area. The work is both novel and interesting, and would satisfy the creative ability of anyone keen and energetic. Minimum qualification B.Sc. degree, with a leaning towards chemistry. Applicants should be of British nationality, not more than 27 years of age, and have completed their Military Service. Wages according to qualifications and experience. Write to Box P228, care of "Plastics." 224-39

Situations Vacant (contd.)

ADDITIONAL ENERGETIC REPRESENTATIVE required for London area by manufacturers of P.V.C. household textiles. Apply to Dunbee, Ltd., Blenheim St., New Bond St., London, W.1 224-36

GENERAL MANAGER
REQUIRED BY
LARGE INDUSTRIAL GROUP
WITH INTERESTS IN THE
UNITED KINGDOM AND ABROAD.

HERE IS THE OPPORTUNITY OF A LIFETIME FOR A MAN OF STRONG PERSONALITY, POSSESSING INITIATIVE AND A DETAILED KNOWLEDGE OF THE PLASTIC EXTRUSION INDUSTRY.

APPLICANTS SHOULD HAVE HELD SIMILAR OR SENIOR ADMINISTRATIVE POSITIONS PREVIOUSLY.

PENSION SCHEME, HOUSING ACCOMMODATION PROVIDED IF NECESSARY, SALARY COMMENSURATE WITH EXPERIENCE.

ONLY APPLICANTS SELECTED FOR INTERVIEW WILL BE NOTIFIED.

Applications in confidence, giving age, education, experience, salaries earned and salary required, to Box P2450, care of "Plastics." 224-74

DRAUGHTSMAN OR TOOLMAKER with drafting experience required for design and development work in injection-moulding factory, N.W.6 area. This is an ideal opportunity for gaining valuable practical experience. Write, stating age, full experience and salary required, to Box P2428, care of "Plastics." 224-2

QUALIFIED PLASTICS CHEMIST required to organize laboratory; must have up-to-date knowledge of p.v.c. compounds. S.E. London area. Write Box P2430, care of "Plastics." 224-1

FIRST-CLASS man wanted with own initiative for buying and selling plastic scrap and allied raw materials. Apply to Box P2337, care of "Plastics." 224-1196

FIRST-CLASS COMPOUNDING SPECIALIST required to start new department for regenerating and colouring of commercial polythene. Prospects: If capital available immediate partnership, if not, good commencing salary with directorship in view. Apply to Box P2335, care of "Plastics." 224-1195

AN EXPERIENCED MAN required, capable of taking charge of a small compression moulding shop. Within 40 miles of London. Well-paid and permanent position. Write stating full details of experience. Box P2220, care of "Plastics." 224-1191

TOOLMAKERS AND MILLERS required, used to plastic moulds; first-class craftsmen need only apply, who will be offered a high rate. Apply: "Seaforth," Watchett Works, Oakhurst Rd., Southend-on-Sea, Essex. 225-1185

PROGRESSIVE COMPANY requires capable assistant for nylon moulding and processing department recently formed. Ideal opportunity for young man wishing to progress, who should preferably have some training or experience in this and kindred materials. Howard Clayton-Wright, Ltd., Wellesbourne, Warwick. 225-1206

ENGINEER required for hydraulic injection moulding and diecasting machines to be solely responsible for installation, setting to work and servicing throughout United Kingdom.

Must have considerable experience of high pressure oil pumps, valves and piping, also machine erection. Some knowledge of electrical control gear useful but not essential. Apply Box P2440, care of "Plastics." 224-59

SALES REPRESENTATIVE wanted by Plastics manufacturing company for the sale of U.F. Moulding Powders and Resins. The territory required to be covered would be approximately the Midlands, Lancashire, Yorkshire, North-East England, with occasional trips to Scotland. The position offers good prospects and salary, and membership of pension and life assurance scheme. Applications will be treated in strict confidence. Apply Box P245, care of "Plastics." 224-18

MANAGER required for London office, capable of representation, covering London and Midlands, with some technical knowledge of the paint, printing ink, plastic and allied trades. Interesting work with prospects; car provided and pension scheme. Apply Box P247, care of "Plastics." 224-16

PRODUCTION MANAGER is required by a Midland electrical engineering company for its moulding factory, which is at present undergoing reorganization. Applicants should be conversant with all aspects of thermosetting and thermo-plastic mouldings. The appointment calls for original thought and progressive up-to-date ideas on methods and processes associated with mouldings. The position affords excellent prospects for the successful candidate, and a high commencing salary will be paid. Applicants should apply in writing stating age, qualifications and previous experience to Box P428, care of "Plastics." 224-15

Situations Vacant (contd.)

SENIOR TECHNICIAN required by substantial company in the North-West for development work on extrusion of thermoplastic materials and lightly plasticized materials. Substantial salary for man with appropriate experience. Reply, giving full particulars and qualifications, to Box P249, care of "Plastics." 224-14

TECHNICAL REPRESENTATIVE required to join the sales staff of polystyrene raw material manufacturers to assist with the sales development of polystyrene moulding materials. Applicants must have experience of the thermoplastics industry with some knowledge of injection moulding. This is a permanent pensionable position with prospects of advancement. State salary required to Box P2418, care of "Plastics." 224-9

PLASTICS DEVELOPMENT ENGINEER required in managerial-technical capacity. Practical experience all branches thermoplastics to aircraft standards essential. Outer West London area. Box P2419, care of "Plastics." 224-8

EXPERIENCED INJECTION MOULDING SHOP FOREMAN for night work. Must have tool setting knowledge. Write full details Box P2420. 224-7

FOR EMPLOYMENT IN CANADA.

CHEMISTS FOR FUNDAMENTAL RESEARCH IN CELLULOSE AND RELATED FIELDS.

A large research organization in the vicinity of Montreal serving one of Canada's largest industries requires:—

2 PHYSICAL CHEMISTS
2 ORGANIC CHEMISTS

with Ph.D. degrees from an accredited university.

Previous experience in cellulose research not necessary, but would be an advantage. A thorough training in the fundamentals of chemistry is expected.

Applicants should be male, 23-30 years old and in good health. They should have a pleasant personality, possess initiative and energy, and be willing to accept responsibility.

Laboratories are modern and well equipped; present staff numbers about 150. Starting salary will depend on education and experience. Travelling expenses up to $350 will be paid.

The Company maintains insurance and retirement plans and offers wide social and recreational facilities, i.e. golf, tennis, skiing, curling, angling, etc.

Apply in writing to Box P2441, giving full particulars of education, experience, interests; also attach a photograph. 226-1197

WELL-KNOWN COMPANY in the East Midlands specializing in the extrusion, moulding and fabricating of plastic materials require the services of technical and production assistants. Candidates will have full opportunity to develop initiative and ability. Salary according to qualifications and experience. Box P2425, care of "Plastics." 224-4

ASSISTANT MOULDING SHOP FOREMAN required with experience of injection and compression techniques. Service knowledge of Peco and Lester machines an advantage. Write stating age and full experience to Box P2429, care of "Plastics." 224-3

MOULDMAKERS REQUIRED. Highest rates of pay for really good men. Chudleigh, Heathman's Yard, Parsons Green, S.W.6. Renown 1370. 224-44

DEVELOPMENT ENGINEER with experience of plastic compression moulding required by electrical manufacturers. Position offers scope for original work on new projects. Location London, E.18. Write Box P2427, care of "Plastics." 225-1205

HAWKER AIRCRAFT LIMITED

Require a DEVELOPMENT ENGINEER for Research into use of

PLASTICS

for aircraft components and tools. Applicants should preferably have University degrees in Mechanical or Chemical Engineering together with experience in the Plastics industry.

Applications giving full details of qualifications and experience, to:—

THE PERSONNEL SUPERVISOR,
HAWKER AIRCRAFT LTD.,
CANBURY PARK ROAD,
KINGSTON-ON-THAMES. 224-75

SENIOR RUBBER OR PLASTICS TECHNOLOGIST required for laboratory in London area. A.I.R.I. or equivalent. Experience in the cable industry desirable but not essential. Knowledge of synthetic rubbers, polythene and Nylon an advantage. Write in confidence giving details of age, experience, etc., to Box P2421, care of "Plastics." 225-1203

Situations Vacant (contd.)

A VACANCY HAS ARISEN in the Plastics Department of a progressive research and development minded company, in the South London area. Applicants should possess a degree in chemistry or physical chemistry, have completed National Service, and be not more than 26 years of age. Previous experience with plastics would be an advantage, but not essential. Please write giving full particulars, to Box P242, care of " Plastics." 225-1199

AN IMPORTANT POSITION is available in our Sales Organization for a capable man to handle the sales of our glass textile products. A considerable expansion of our production and of our sales has been planned and there are good opportunities in our company for a man who has a sound knowledge of industrial plastics and preferably also some experience in selling glass textiles. Applications are invited from men under the age of 40 who are seeking a permanent and well-paid career with a large organization, and who feel that they have the background and experience which are needed for a position of this kind. All applications should be addressed to the Home Sales Manager, Turner Brothers Asbestos Co., Ltd., Spotland, Rochdale. 224-47

UNIVERSAL METAL PRODUCTS, LTD., have the following vacancies in their plastics division at Salford factory:—

(a) Two foremen, one each for the compression and injection moulding departments. Applicants should have sound practical experience of moulding technique and be capable of handling day-to-day problems on the shop floor.

(b) Manager for the plastics division. This is an executive position of considerable responsibility requiring sound management experience in compression and injection moulding.

Men possessing ability, initiative and enthusiasm are required for these positions in a company which is progressive and expanding. Pension scheme.

Applications, stating position required, age, training and experience, salary or wage required and date available, to the Staff Manager, Universal Metal Products, Ltd., Langley Rd., Pendleton, Salford, 6. 224-32

INJECTION MOULDING charge hand required for good-class work. Previous similar experience essential. Contributory pension scheme. Apply, Personnel Manager, Phœnix Telephone and Electric Works, Ltd., The Hyde, Hendon, N.W.9. Colindale 7243. 224-31

PLASTICS TECHNOLOGIST with proved experience in P.V.C. compounding and testing methods required to take over control of physical testing laboratory. Salary according to experience. Contributory pension scheme and canteen. Submit full details to Vinatex, Ltd., Devonshire Rd., Carshalton, Surrey. 224-29

Situations Vacant (contd.)

VINATEX, LTD., require for their P.V.C. laboratories two junior assistants.

(a) Young man of Inter. B.Sc. or equivalent, for development work on P.V.C. pastes. Similar previous experience will be considered in lieu of qualifications. Facilities given for part-time study.

(b) Young man who has completed national service, for training in colour matching and colour control. Preference given to applicant with previous experience in this type of work.

Salaries according to age and ability. Pension scheme and canteen facilities. Applications in writing to Vinatex, Ltd., Devonshire Rd., Butter Hill, Carshalton, Surrey. 224-30

APPLICATIONS ARE INVITED for the position of assistant works manager, North London area. Approx. 200 employees. Previous practical experience preferred in hard and soft rubber and in plastics. Knowledge of lead acid accumulator industry an advantage. Age 24-45. Salary about £700 p.a., depending upon qualifications. Details of education, experience, etc., to Haddon's, Salisbury Square, London, E.C.4. (Quote M.1529.) 224-24

M. AND B. PLASTICS, LTD., require a sales representative for territory covering South London and Kent, age 20-23, previous sales experience desirable, but not essential, provided sound education with scientific or technical background. Residence in the South London area is necessary. Permanent and pensionable position with prospects of advancement. Apply initially in writing to the Personnel Officer, May and Baker, Ltd., Dagenham, Essex, quoting reference No. 56. 224-22

TECHNICIANS REQUIRED by company in the North East engaged in the production of thermosetting moulding materials and allied products. Applicants should have a good practical experience of moulding processes and tool design and preferably conversant with Quality Control methods. Apply Box P2456, care of " Plastics." 224-78

PLASTICS TECHNOLOGIST. Bristol Aircraft, Ltd., Weston-super-Mare, have an interesting vacancy for a plastics technologist for guided weapons and helicopter projects. Duties include carrying jobs through from the design and tooling stage and also design and development work. Minimum qualifications are a technical school education and O.N.C. standard. Preference will be given to applicants with experience in similar work.

Please apply giving full details of experience and qualifications and quoting W/JP.19, to the Personnel Manager, Bristol Aircraft, Ltd. (Weston Works), Oldmixon, Weston-super-Mare. 224-76

Situations Vacant (contd.)

QUALIFIED CHEMIST. A vacancy for a qualified chemist exists in the Technological Division of Smith and Nephew Research, Ltd., the Research Organization for Smith and Nephew Associated Companies, Ltd., manufacturers of a wide variety of surgical dressings, plasters, toilet and pharmaceutical preparations and allied products. This appointment is being made to meet the demands of an expanding research programme and applications are invited from those with a University Degree or equivalent. Candidates should have a background knowledge of physical chemistry but the main interest should lie in the practical application of raw materials in manufacturing processes. The principal fields of work will be concerned with pressure sensitive adhesive products, speciality bandages and industrial tapes. Knowledge of the properties of textiles, plastics and rubber would be desirable and practical experience in some branch of industry would be a definite asset. The salary of candidates, whose age should not be over 30 years, will depend on qualifications and experience, but will not be less than £700 per annum. Write to The Personnel Officer, Smith and Nephew Research, Ltd., Hunsdon Laboratories, Ware, Herts. 224-79

SITUATIONS WANTED

FOREMAN/MANAGER (INJECTION) desires change, excellent practical experience materials, machines, tools. Development work undertaken. Capable taking complete charge. London area. Box P2426, care of " Plastics." 224-x3978

PIONEER IN RESIN-GLASS, with nucleus of staff, seeks capital for establishment of company to manufacture resin-glass products, or would consider setting up department in existing organization. Wide experience of all aspects with large company in senior position. Box P2435, care of " Plastics." 224-xB3623

EXPERIENCED REPRESENTATIVE, 43, engineering background, knowledge compression and injection moulds, requires situation with progressive company, London and Home Counties. Box P2454, care of " Plastics." 224-x4746

TECHNOLOGIST B.Sc., A.P.I., 30. Experience: five years resin-glass research, development, production, management, on wide range of processes and applications, previously polymer research and evaluation—seeks executive position with progressive company where experience and initiative can be used to full advantage. Box P2434, care of " Plastics." 224-xA3623

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Plastics

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